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RDT&E PROJECT NO. 1M643303D54801

USATECOM PROJECT NO. 8-3-7400-06/07/08

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INTEGRATED ENGINEERING AND SERVICE TEST OF
MEAL, READY-TO-EAT, INDIVIDUAL
(INTERMEDIATE CONDITIONS)

PARTIAL REPORT

BY

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1LT, Infantry
USAIB

RICHARD D. EZZARD
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USAAESWBD

JUNE 1967

U S ARMY
GENERAL EQUIPMENT TEST ACTIVITY
FORT LEE, VIRGINIA

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RDT&E PROJECT NO. 1M643303D54801

USATECOM PROJECT NO. 8-3-7400-06/07/08

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MEAL, READY-TO-EAT, INDIVIDUAL
(INTERMEDIATE CONDITIONS)

TEST REPORT

BY

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JUNE 1967

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U. S. ARMY
GENERAL EQUIPMENT TEST ACTIVITY
FORT LEE, VIRGINIA

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DEPARTMENT OF THE ARMY
HEADQUARTERS, U. S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

AMSTE-BC

20 JUL 1967

SUBJECT: Partial Report, Integrated Engineering and Service Test of Meal, Ready-to-Eat, Individual (Intermediate Conditions), RDT&E Project No. 1M643303D54801, USATECOM Project No. 8-3-7400-06/07/08

TO: Commanding General
US Army Materiel Command
ATTN: AMCRD-JI
Washington, D. C. 20315

1. References:

a. Letter, AMSTE-BC, HQ USATECOM, 8 June 1967, subject: Arctic Service Test Report for Meal, Ready-to-Eat, Individual, Under Arctic Winter Conditions, RDT&E Project No. 1M643303D54801, USATECOM Project No. 8-3-7400-09.

b. Letter, STEDP-DA-E, Dugway Proving Ground, 29 June 1967, subject: Input Data for Final Report of Integrated Engineering and Service Test of Meal, Ready-to-Eat, Individual (Intermediate Conditions), RDT&E Project No. 1M643303D54801, USATECOM Project No. 8-3-7400-11.

2. Subject report is approved by this headquarters. Copies are forwarded for comment and/or concurrence. (Incl 1)

3. Subject report is a partial report in that it does not include results of Dugway Proving Ground tests to determine the extent to which the Meal, Ready-to-Eat, Individual met the military characteristics relative to chemical and biological (CB) resistance of cases and packages. These results have been provided to this headquarters, reference 1b, and are included in succeeding paragraphs of this final USATECOM position letter. These results will also be published as an addendum to subject report and furnished to all report recipients by 31 July 1967. Arctic test results (reference 1a) are also considered in this position.

4. Summary of Findings:

a. The extent to which the Meal, Ready-to-Eat, Individual, met

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SUBJECT: Partial Report, Integrated Engineering and Service Test of Meal, Ready-to-Eat, Individual (Intermediate Conditions), RDT&E Project No. 1M643303D54801, USATECOM Project No. 8-3-7400-06/07/08

the military characteristic pertaining to storage without refrigeration for a minimum of two years was not determined since this was beyond the time scope of this testing.

b. Tests to determine the extent to which the Meal, Ready-to-Eat, Individual, met the military characteristics relative to CB resistance of cases and packages provided these results:

(1) Receipt inspection revealed molds and an unidentified insect on individual Meals, Ready-to-Eat and ruptures and incomplete sealing of component food envelopes.

(2) Shipping containers of Meal, Ready-to-Eat, Individual and Meal, Combat, Individual, were grossly contaminated after exposure to field concentrations of chemical agent VX and biological simulant agent BG.

(3) The chemical agent and biological simulant agent penetrated the shipping containers and were detected on the packaging of individual meals.

c. The Meal, Ready-to-Eat, Individual, met the requirements of the military characteristic pertaining to aerial delivery except for the condition when airdropped without parachute with cases lashed together and without Pad, Energy Dissipating, Honeycomb.

d. The Meal, Ready-to-Eat (MRI) satisfactorily met the remaining requirements of the military and technical characteristics except for the following deficiency and shortcomings:

(1) Deficiency:

During pre-issue inspection of each MRI, packaging damage (defective seal, seal failure, gas formation) was encountered. While this occurred with a small percentage of items, it is considered a deficiency because it presents a safety hazard to troops. This deficiency occurred in 1 percent of items in the Arctic test and 0.35 percent for dry pack components and 0.30 percent for wet pack components in the Intermediate Conditions Test.

(2) Shortcomings:

(a) The gross weight per meal exceeded the one pound limitation.

(b) The packaging of the plastic spoon ruptured resulting in inadequate sanitary protection.

20 JUL 1967

AMSTE-SC

SUBJECT: Partial Report, Integrated Engineering and Service Test of Meal, Ready-to-Eat, Individual (Intermediate Conditions), RDT&E Project No. 1M643303D54801, USATECOM Project No. 8-3-7400-06/07/08

(c) The perfumed odor of the cleansing towels was objectionable from a security standpoint.

(d) The bread and chocolate nut roll were marginally acceptable from a palatability standpoint.

(e) The apricot and orange cereal bars were unacceptable from a palatability standpoint.

(f) Significant decreases in palatability of 17 of the 40 food components (42.5 percent) occurred after 6 months storage at 100°F. Seven of these are the major components in 7 different menus.

(g) The rehydration time for dehydrated fruits after 6 months of storage at 100°F and after shorter periods of storage at higher temperatures was excessive.

(h) Over half of the soldiers participating in the Arctic test reported that menus 6, 7, and 9 did not contain a sufficient quantity of food to satisfy the appetite under Arctic winter conditions and over one-third of the soldiers reported that all other menus did not contain a sufficient quantity of food.

5. Conclusions:

a. The menus of the Meal, Ready-to-Eat, Individual, are less acceptable from a palatability standpoint than the menus of the Meal, Combat, Individual, when consumed hot or cold.

b. While the ratings of most of the components of the Meal, Ready-to-Eat, Individual, are sufficiently high to be considered acceptable, the level of the ratings are such that overall improvements are indicated, particularly in the bread and cake items.

c. The deficiency with regard to defective flexible package seals presents an unacceptable safety hazard.

d. The method of aerial delivery where Meal, Ready-to-Eat, Individual, is airdropped without parachute with cases lashed together without Pads, Energy Dissipating, Honeycomb should not be used. Other suitable means are available.

e. The Meal, Ready-to-Eat, Individual is not suitable for US Army use.

AMSTE-BC

20 JUL 1967

SUBJECT: Partial Report, Integrated Engineering and Service Test of Meal, Ready-to-Eat, Individual (Intermediate Conditions), RDT&E Project No. 1M643303D54801, USATECOM Project No. 8-3-7400-06/07/08

6. Recommendations. It is recommended that:

a. The Meal, Ready-to-Eat, Individual, be considered unsuitable for US Army use until the deficiency and as many as practicable of the shortcomings are corrected.

b. Every effort be made to improve the palatability of the components of the Meal, Ready-to-Eat, Individual, to a level of soldier acceptance that is at least equal to that for the Meal, Combat, Individual.

c. The cereal bars be replaced with an acceptable component.

d. The modified Meal, Ready-to-Eat, Individual, be returned to USATECOM for retest to insure that the deficiency and as many as practicable of the shortcomings have been corrected.

FOR THE COMMANDER:

Robert B. Tully
ROBERT B. TULLY
LTC GS
Dir, Inf Mat Test

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**U.S. ARMY GENERAL EQUIPMENT TEST ACTIVITY
FORT LEE, VIRGINIA**

USATECOM 8-3-7400-06/07/08

**Partial Report of
Integrated Engineering and Service Test of
Meal, Ready-to-Eat, Individual
(Intermediate Conditions)**

**Conducted at Camps Pickett and A.P. Hill and Fort Lee, Virginia;
Fort Bragg, North Carolina; Fort Benning,
Georgia; Fort Polk, Louisiana; Dugway
Proving Grounds; and the Panama Canal Zone**

June 1967

Abstract

An Integrated Engineering and Service Test of Meal, Ready-to-Eat, Individual, was conducted under intermediate climatic conditions during the period June 1966 to May 1967 to determine its technical performance and safety characteristics as described in the Military and Technical Characteristics, and as indicated by the particular design, and to determine its suitability for use by the Army.

One deficiency and seven shortcomings were found. The deficiency was a safety hazard to the user because of spoiled foods and defective packaging. It was concluded that: the experimental ration menus are less acceptable from a palatability standpoint than the standard menus when consumed both hot and cold; the level of ratings of the components of the experimental meal though generally acceptable are such that overall improvements are indicated particularly in the bread and cake items; and the experimental meal is not suitable for Army use under intermediate climatic conditions.

It was recommended that: the palatability of the components of the Meal, Ready-to-Eat, be improved to a level of acceptance that is at least equal to that for the standard meal; the cereal bars be replaced with an acceptable component; the Meal, Ready-to-Eat, Individual, be considered not suitable for use by the Army under intermediate climatic conditions until the deficiency and as many as possible of the shortcomings are corrected; and the modified meal be returned for a Check Test.

FOREWORD

Executive responsibility for the test was assigned to the U. S. Army General Equipment Test Activity (USAGETA), Fort Lee, Virginia (App. IV, Ref. 6). The U. S. Army Infantry Board (USAIB), Fort Benning, Georgia; the U. S. Army Airborne, Electronics and Special Warfare Board (USAAESWBD), Fort Bragg, North Carolina; the U. S. Army Tropic Test Center (USATTC), Fort Clayton, Canal Zone; and Dugway Proving Grounds, Dugway, Utah, were designated as supporting activities. The USAAESWBD, in coordination with USAGETA, planned and conducted air delivery tests of the Meal, Ready-to-Eat, Individual and provided the results to USAGETA. The USATTC provided support in the Panama storage phase. Dugway Proving Grounds planned and conducted the required testing and will provide data pertaining to the chemical and biological evaluation phase for publication at a later date. USAGETA and USAIB jointly planned and conducted the field use phases. USAGETA planned and conducted the remainder of the test as reported herein.

TABLE OF CONTENTS

	<u>PAGE</u>
ABSTRACT	i
FOREWORD	iii
 <u>SECTION 1. INTRODUCTION</u>	
1.1 BACKGROUND	1
1.2 DESCRIPTION OF MATERIEL	2
1.3 TEST OBJECTIVES	2
1.4 SUMMARY OF RESULTS	4
1.5 CONCLUSIONS	5
1.6 RECOMMENDATIONS	5
 <u>SECTION 2. DETAILS OF TEST</u>	
2.1 INTRODUCTION	7
2.2 PREOPERATIONAL INSPECTION AND PHYSICAL CHARACTERISTICS	7
2.3 COMPATIBILITY AND PORTABILITY	11
2.4 DURABILITY	16
2.5 WATER, INSECT, AND RODENT RESISTANCE	17
2.6 NUTRITIONAL ADEQUACY	20
2.7 PALATABILITY	22
2.8 TRANSPORTATION AND HANDLING	35
2.9 AIR DELIVERY	38
2.10 GENERAL COMMAND AND TROOP ACCEPTANCE	41
2.11 CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL PROTECTION	49
2.12 STORAGE AND TRANSIT EVALUATION	50
2.13 HUMAN FACTORS EVALUATION	62
2.14 VALUE ANALYSIS	63
2.15 SAFETY	63
 <u>SECTION 3. APPENDICES</u>	
I TEST DATA	69
II FINDINGS	93
III DEFICIENCIES AND SHORTCOMINGS	101
IV REFERENCES	103
V DISTRIBUTION LIST	105
	v

SECTION 1. INTRODUCTION

1.1 BACKGROUND

The Meal, Ready-to-Eat, Individual, is part of a developmental simplified combat feeding system as outlined in paragraph 1439f, Combat Development Objective Guide. This combat feeding system consists of three types of packaged meals (Meal, Quick-Serve; Meal, Uncooked, 25-Man; and Meal, Ready-to-Eat, Individual) which commanders can use interchangeably depending on prevailing tactical and logistical conditions. These meals are designed to be used as follows: the Meal, Quick-Serve, for small group feeding; the Meal, Uncooked, 25-Man, for large-group feeding; the Meal, Ready-to-Eat, Individual, for issue to individuals and used for troop feeding at times when it is impractical to provide either small or large-group feedings. The latter meal is designed as the eventual replacement of the Meal, Combat, Individual.

Development of components for the Meal, Ready-to-Eat, began in 1959. In 1962, certain items were considered ready for preliminary evaluation and a feasibility study was scheduled. Four types each of dehydrated fruit and meat patties were substituted for comparable heat-processed (canned) items in the Meal, Combat, Individual, and the substituted meals were compared with the standard Meal, Combat, Individual, during May 1963 (App. IV, Ref. 1).

In February 1964, six menus of the Meal, Ready-to-Eat, Individual, were made available for testing. An Engineer Design test of Menus 1, 4, and 6 was conducted concurrently with an Engineering Test of Menus 2, 3, and 5 during the period 10 February to 24 April 1964 at Camp Pickett, Camp A.P. Hill, Camp Pendleton, Fort Story, and Fort Lee, Virginia. Results of these tests were reported in references 2 and 3 of Appendix IV. Developments since the conduct of these tests resulted in redesign of original menus to include flexibly packaged, heat-processed, and dehydrated meats and other components so that 12 menus were available for this test. Further, the carton-stove concept was eliminated and the canteen cup was designated as a water heating vessel for use in the preparation of meals when appropriate.

The Engineering and Service test reported herein was conducted to determine the suitability of the experimental meal for U. S. Army use under intermediate climatic conditions as the replacement for the Meal, Combat, Individual.

1.2 DESCRIPTION OF MATERIEL

a. Meal, Ready-to-Eat, Individual

The Meal, Ready-to-Eat, Individual (Fig. 1 and 2), is an individual, flexibly packaged meal-type ration which is designed to be eaten hot or cold. The ration consists of twelve menus, plus alternate Menus 1a and 4a. All menus, except Menus 1 and 4, contain heat-processed (wet-pack) rather than dehydrated meat components. The menus consist of heat-processed and dehydrated foods; bread roll; baked dessert items; cereal bars; cheese spread, jelly, or peanut butter; accessory packets; plastic spoons; and paper cleansing towels. Items are packaged in plastic-foil-plastic laminated bags or pouches. In addition, the heat-processed meat items are overpacked in a fiberboard folder and the baked items (bread and dessert) are overpacked in a fiberboard box. The packaged components are packed in a solid fiberboard meal carton with approximate dimensions of 4 3/4 by 2 1/2 by 7 1/4 inches. Twelve different menus are packed in a V2s fiberboard shipping case with sleeve and metal straps. One-half of the cases provided for this test included Menus 1 and 4 while the other half included the alternate Menus 1a and 4a.

b. Meal, Combat, Individual

The standard Meal, Combat, Individual, as currently authorized for use as an individual operational ration, was used as the control item. This meal-type ration consists of 12 menus with each menu containing heat-processed foods and an accessory packet. The food items are packed in metal cans which are overwrapped in a solid fiberboard carton. Accessory items, in a flexible package, are included in each meal. Twelve meals are packed in a V2s shipping container with sleeve and wire bands.

1.3 TEST OBJECTIVES

To determine the technical performance and safety characteristics of the Meal, Ready-to-Eat, Individual, under intermediate conditions, as described in the Military and Technical Characteristics (App. II), and as indicated by the particular design, and to determine the suitability of the Meal, Ready-to-Eat, Individual, for use by the Army.

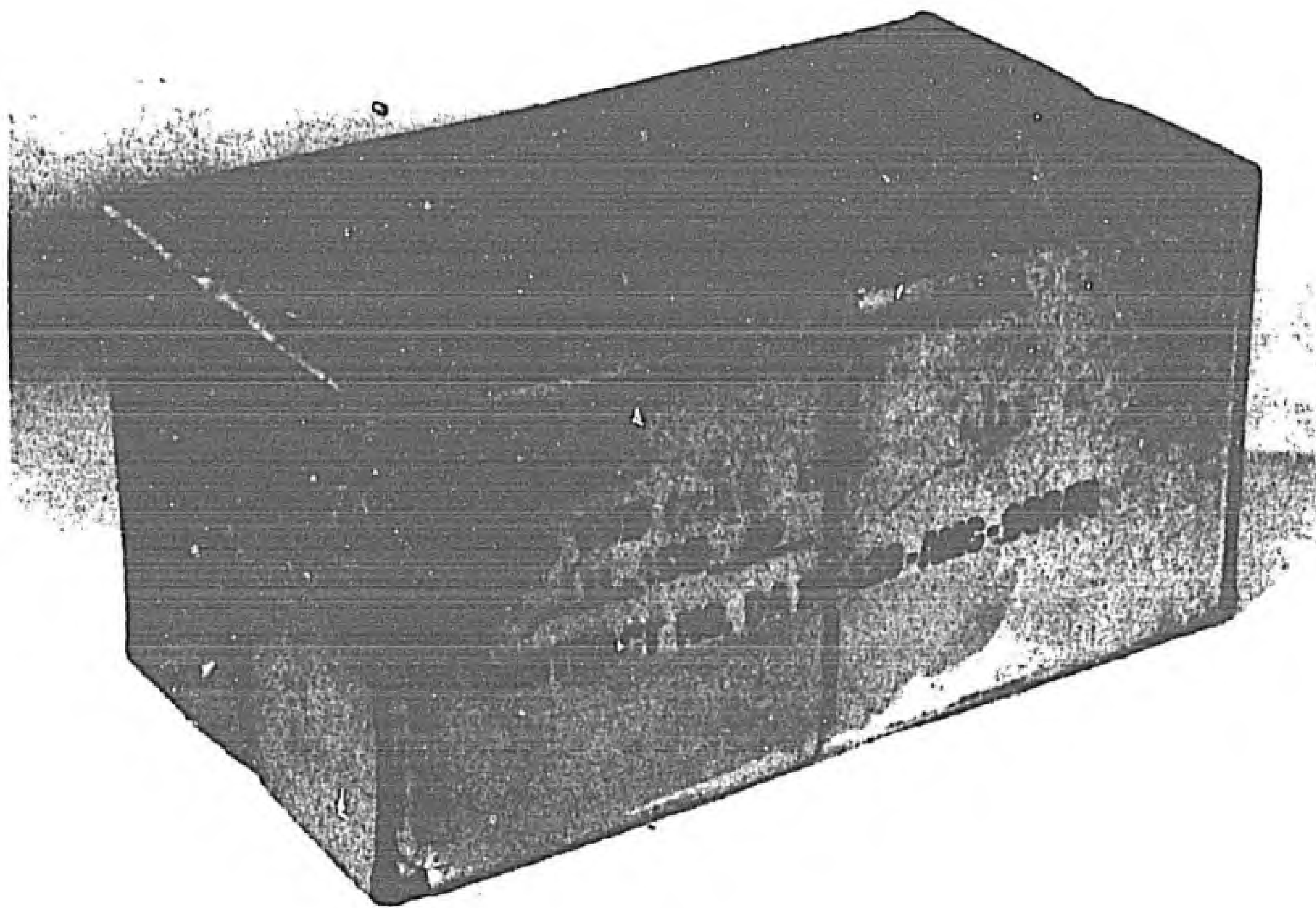
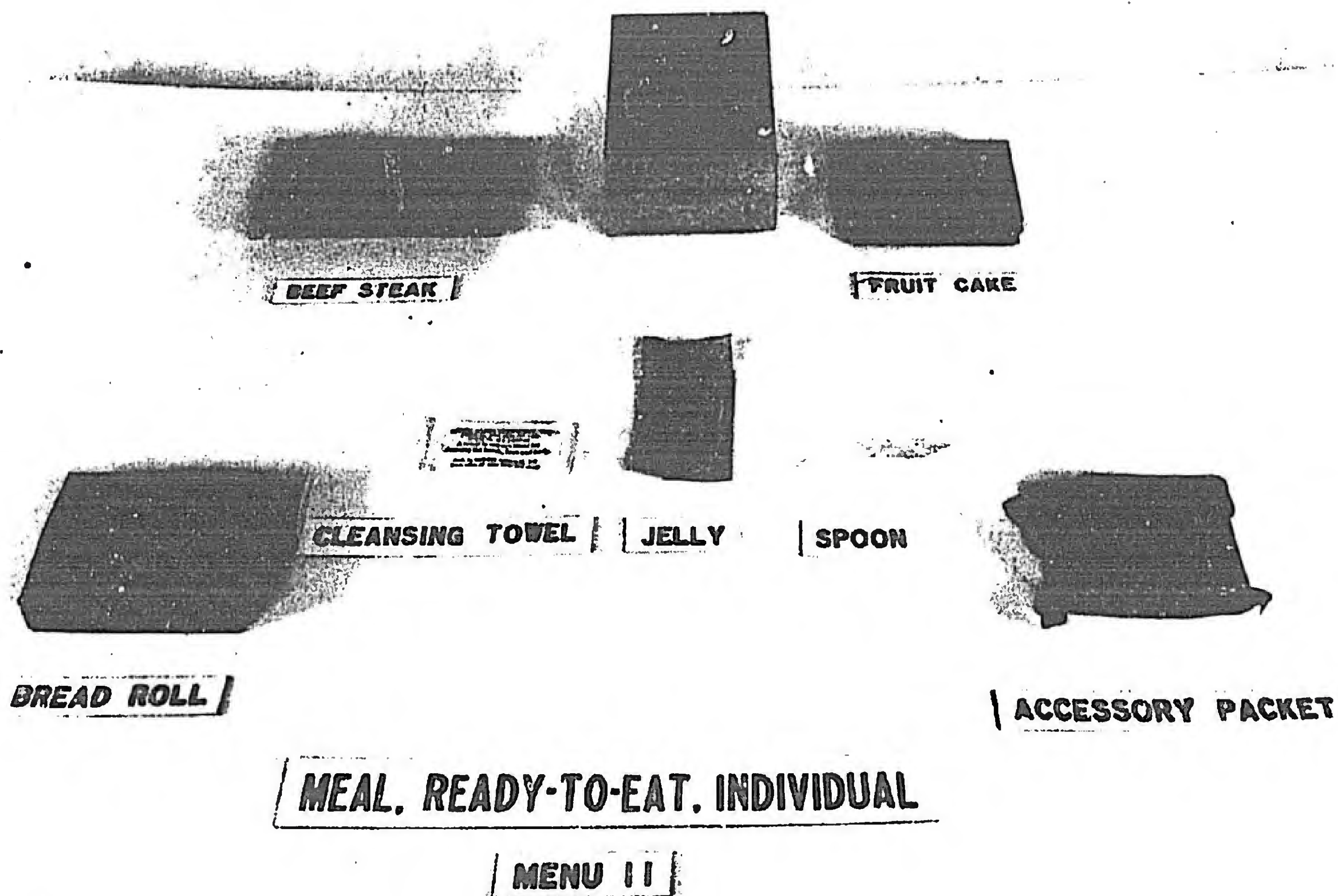


Figure 1. Meal, Ready-to-Eat, in shipping case.



US ARMY
GETA
FORT LEE, VA.

Figure 2. Display of components of typical menu.

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1.4 SUMMARY OF RESULTS

a. The extent to which the Meal, Ready-to-Eat, Individual, met the Military Characteristics (App. II, Par. 17) pertaining to storage without refrigeration for a minimum of 2 years was not determined.

b. Testing necessary to determine the extent to which the Meal, Ready-to-Eat, Individual, met the Military Characteristics (App. II, Par. 23) pertaining to chemical and biological protection was not completed in sufficient time to be included in this report, and results will be published at a later date.

c. The Meal, Ready-to-Eat, Individual, satisfactorily met the requirements of the Military and Technical Characteristics (App. II) except for the following deficiency and shortcomings.

(1) Deficiency

A safety hazard to the user exists because of spoiled foods and defective packaging resulting from faulty processing or packaging of components at the point of manufacture or assembly (Par. 2.2, 2.8, and 2.15).

(2) Shortcomings

(a) The gross weight per meal exceeds the one pound limitation (Par. 2.2).

(b) The packaging of the plastic spoons was ruptured or torn thereby not providing adequate sanitary protection (Par. 2.2).

(c) The perfumed odor of the cleansing towels is objectionable from a security standpoint (Par. 2.2).

(d) The bread and chocolate nut roll are marginally acceptable from a palatability standpoint (Par. 2.7).

(e) The apricot and orange cereal bars are unacceptable from a palatability standpoint (Par. 2.7).

(f) Significant decreases in palatability of 17 of the 40 food components (42.5 percent) occurred after 6 months of storage at 100°F. Seven of these are the major component in 7 different menus (Par. 2.12).

(g) The rehydration time for dehydrated fruits after 6 months of storage at 100°F. and after shorter periods of storage at higher temperatures is excessive (Par. 2.12).

1.5 CONCLUSIONS

a. The menus of the Meal, Ready-to-Eat, Individual, are less acceptable from a palatability standpoint than the menus of the Meal, Combat, Individual, when consumed both hot and cold.

b. While the ratings of most of the components of the Meal, Ready-to-Eat, Individual, are sufficiently high to be considered acceptable under field conditions the level of the ratings are such that overall improvements are indicated, particularly in the bread and cake items.

c. A safety hazard exists because of the presence of spoiled foods and improper sealing of flexible packages.

d. The Meal, Ready-to-Eat, Individual, in its present configuration is not suitable for Army use under intermediate climatic conditions.

1.6 RECOMMENDATIONS

It is recommended that:

a. Every effort be made to improve the palatability of the components of the Meal, Ready-to-Eat, Individual, to a level of acceptance that is at least equal to that for the standard Meal, Combat, Individual, which it is designed to replace.

b. The cereal bars be replaced with an acceptable component.

c. The Meal, Ready-to-Eat, Individual, be considered not suitable for use by the Army under intermediate climatic conditions until the deficiency and as many as possible of the shortcomings are corrected.

d. The modified Meal, Ready-to-Eat, Individual, be returned for a Check Test to insure that the deficiency and as many as possible of the shortcomings have been corrected.

SECTION 2. DETAILS OF TEST

2.1 INTRODUCTION

The integrated Engineering and Service test of the Meal, Ready-to-Eat, Individual (Intermediate Conditions) was conducted in both simulated and normal field use environments and under climatic conditions as specified in Change 1 of Army Regulation 705-15, during the period June 1966 to May 1967. Both subjective and objective testing techniques and methodology were used in the test to determine the quantitative adequacy, acceptability, utility, air delivery capability, and other factors relative to the overall suitability of the menus, components, and packaging for use by the individual soldier and the Army. Where possible, the experimental meal was tested on a comparative basis with the standard meal which it is designed to replace.

Certain subtests were conducted at Fort Lee, Virginia, utilizing facilities, equipment, and personnel of the U. S. Army General Equipment Test Activity. The subtest pertaining to air delivery was conducted at Fort Bragg, North Carolina, utilizing facilities, equipment, and personnel of the U. S. Army Airborne, Electronics and Special Warfare Board. The field use subtests were conducted jointly by the U. S. Army Infantry Board and U. S. Army General Equipment Test Activity utilizing as test participants troops from Fort Polk, Louisiana; Fort Bragg, North Carolina; and Fort Lee and Fort Belvoir, Virginia. The subtest pertaining to CB protection was conducted at Dugway Proving Grounds, Dugway, Utah, utilizing facilities, equipment, and personnel of that activity (Par. 2.11). The Panama storage phase was conducted jointly by the U. S. Army Tropic Test Center and U. S. Army General Equipment Test Activity utilizing storage facilities at Fort Sherman, Canal Zone.

2.2 PREOPERATIONAL INSPECTION AND PHYSICAL CHARACTERISTICS

2.2.1 Objective

To determine whether the Meal, Ready-to-Eat, menus, components, and packaging, as appropriate, meet the following Military and Technical Characteristics (App. II):

- a. Shall be of minimum weight and bulk consistent with other requirements. Gross weight shall not exceed 1 pound (App. II, Pars. 2 and 27).

b. The case in which the meals are packaged shall be of minimum weight and bulk consistent with other requirements. Gross weight shall not exceed 25 pounds (App. II, Pars. 3 and 27).

c. Components shall be packaged to the maximum extent in flexible containers (App. II, Par. 4).

d. Shall require no preparation other than opening packages and shall require no water except for the reconstitution of drinks (App. II, Pars. 9 and 27).

e. Shall include all accessories necessary for consumption of the meal, except canteen, canteen cup, and water (App. II, Pars. 10, 27, and 28).

f. An accessory packet containing cigarettes, matches, toilet paper, chewing gum, and cleaning patches will be included in each meal (App. II, Par. 11).

2.2.2 Method

Generally, the extent to which the Meal, Ready-to-eat, met the characteristics cited above could be determined simply by examination of the physical characteristics of cases, meals, and components. Thirty cases of meals were selected randomly from the total cases of meals available at Fort Lee and the weights, volume measurements, and other examinations made of the meals and cases. Fifteen of the above cited cases included Menus 1 and 4 and fifteen cases included Menus 1a and 4a. Each selected case and each meal within each case were first weighed on a calibrated scale and volume measurements were taken. The meals within these 30 cases (360 meals) were then opened and examined for conformance with other pertinent characteristics.

As part of the safety evaluation of the experimental meal during this subtest (Par. 2.15), a 100-percent inspection was made of all meals to be issued to test participants for consumption as described in paragraph 2.7. This inspection was accomplished by representatives of Natick Laboratories, USAGETA, and USAIB. Components with any visible evidence of spoilage, package failure, or questionable condition were removed and replaced with like unspoiled or undamaged items. Records were maintained of the number and types of failures.

2. 2. 3 Results

Data pertaining to the average weight and volume of each menu of the Meal, Ready-to-Eat, Individual, are shown in Table I. The comparative overall average weight and volume of the Meal, Ready-to-Eat, and the Meal, Combat, Individual, by meal and case are shown in Table II.

The preoperational inspection showed that all menu components were packaged in flexible packages; the experimental meal contained all essential accessories necessary for the consumption of the meal by the soldier in the field; and that all food items could be consumed, if necessary, as found in the package except for rehydration of beverages (coffee and cocoa). Further, no discrepancies were found during the inspection of meals with regard to prescribed contents for the accessory packet as shown in the Military Characteristics. It was noted throughout the inspection that the plastic covering for the spoon in each meal had been punctured by the sharp pointed end of the spoon handle. If the purpose of this covering is to keep the spoon sterile, it will be necessary to change either the design of the spoon or packaging material for proper protection. Also, it was noted that the cleansing towel included in each meal had a strong perfumed odor which could create a security problem when used in combat.

Data pertaining to the damages and failures found during the 100-percent inspection of meals for troop consumption are shown in paragraph 2. 8 under the Transportation and Handling subtest.

2. 2. 4 Analysis

Examination of Tables I and II shows that the average weight of the Meal, Ready-to-Eat, menus exceeds the one pound gross weight per meal limitation shown in the Military and Technical Characteristics (App. II, Pars. 2 and 27). On the other hand, the average case weight of the Meal, Ready-to-Eat, was well within the 25-pound gross weight per case limitation. The average weight for individual meals and cases for the Meal, Ready-to-Eat, is approximately 0.4 and 7.6 pounds less, respectively, than that for the Meal, Combat, Individual, which indicates some possible advantages both from a logistical and a user standpoint. There are no specific volume limitations stipulated in the Military and Technical Characteristics other than minimum bulk consistent with other requirements. There was no observed waste of space within either the

TABLE I
AVERAGE WEIGHT AND VOLUME OF
MEAL, READY-TO-EAT MENUS

(Based on Measurements of 30 Cases)

Menu	Weight (Lbs.)		Avg. Volume (Cu. Ft.)
	Avg.	Range	
1	1.22	1.16 - 1.28	.052
1a	1.19	1.16 - 1.20	.051
2	1.28	1.23 - 1.33	.054
3	1.23	1.19 - 1.28	.054
4	1.23	1.09 - 1.27	.053
4a	1.53	1.45 - 1.58	.051
5	1.20	1.16 - 1.27	.052
6	1.29	1.19 - 1.34	.052
7	1.28	1.25 - 1.30	.053
8	1.21	1.08 - 1.30	.052
9	1.11	1.08 - 1.22	.053
10	1.13	1.02 - 1.19	.052
11	1.31	1.27 - 1.39	.052
12	1.32	1.28 - 1.36	.052

TABLE II
OVERALL AVERAGE WEIGHT AND VOLUME OF THE MEAL,
READY-TO-EAT, AND THE MEAL, COMBAT, INDIVIDUAL

(Based on Measurements of 30 Cases)

Ration	Avg. Wt. (Lbs.)		Avg. Volume (Cu. Ft.)	
	Meal	Case	Meal	Case
Meal, Ready-to-Eat				
Cases w/Menus 1 & 4	1.23	18.51	.053	.78
Cases w/Menus 1a & 4a	1.26	18.58	.052	.78
Meal, Combat, Individual	1.64	24.10	.051	.80

individually packaged meals or in the meal cases of the Meal, Ready-to-Eat; however, minor wastage of space was observed in the packaging of the Meal, Combat, Individual, in the area between the sides of the individual meal cartons and the meal case. There was no substantial difference between the meal and case volume of the experimental and standard meals.

It was found during this test that the components of the Meal, Ready-to-Eat, could be consumed, if necessary, as found in the package (i. e., without preparation) except for reconstitution of beverages (coffee and cocoa). However, as shown in Appendix I-A, all menus except 5 (4a, 6, 8, 9, and 11) contain one or more dehydrated components and the individual soldier would probably prefer to reconstitute these items prior to consumption if given a choice and if the tactical situation permits. Likewise, the meat components and beverages (coffee and cocoa) could be consumed cold if necessary; however, the individual soldier would probably prefer to heat these items prior to consumption.

Overall, the Meal, Ready-to-Eat, meets the requirements of the Military and Technical Characteristics stated above except for the one pound gross weight per meal limitation. The failure of the experimental meal to meet this requirement is considered a shortcoming. Further, the improper packaging or design of the plastic spoon and the perfumed odor of the cleansing towels are considered shortcomings. The redesign of the plastic spoon or its packaging and the elimination of the perfumed or other strong odors from the cleansing towels included in each meal are indicated.

2.3 COMPATIBILITY AND PORTABILITY

2.3.1 Objective

To determine the compatibility of the Meal, Ready-to-Eat, Individual, with the pockets of field clothing and the ability of the soldier to carry a 1-day supply (3 meals) while performing normal field duties.

2.3.2 Method

In general, determination of the compatibility of the packaging of the experimental meal with the pockets of the soldier's field uniform was on the basis of data obtained and reported in the previous Engineering Test

of this meal-type ration (App. IV, Ref. 3). The field clothing used in this test included the standard field jacket and the fatigue uniform (trousers and shirt, Man's, Cotton Sateen, OG107). The configuration of the individual components of the current Meal, Ready-to-Eat, is essentially the same as for individual components of the meal previously tested. The configuration of both the current and previous rations required the dispersal of individual meal components when carried in the pockets of the soldier dressed in the field clothing referred to above.

Additional data regarding compatibility of the packaging with the pockets of the soldier's field clothing and data pertaining to portability characteristics of both the Meal, Ready-to-Eat, and the Meal, Combat, Individual, were obtained during this test while test participants were undergoing simulated combat tasks. Personnel of four Advanced Infantry Training Companies at Fort Polk, Louisiana, carried both the experimental and standard meals in the pockets of their field clothing and in their packs while performing field training during the field use phases (Par. 2.7). The clothing and equipment used by these personnel are shown in Appendix I-B. In addition, Special Forces personnel, Fort Bragg, North Carolina, carried the experimental Meal, Ready-to-Eat, in their clothing and pack while undergoing field training during the field use phases (Par. 2.7). The standard Meal, Combat, Individual, was not carried by Special Forces personnel since these individuals only evaluated the experimental meal. Near the end of the field training period of both groups, personnel of the units completed questionnaires pertaining to the portability characteristics of the meals, as appropriate.

2.3.3 Results

Data as to the compatibility of packaging with pockets of field clothing reported in the previous Report of the Engineering Test of the Meal, Ready-to-Eat (App. IV, Ref. 3) showed that one meal can be dispersed as individual components in the pockets of the field jacket without unduly affecting the soldier's mobility. Further, it was found that one meal can be dispersed in the pockets of the fatigue trousers and shirt of the soldier without any major difficulties; however, the wet-pack meat and fruit components were too long in some instances to permit closure of the pockets when placed in the fatigue shirt pockets but these items could be carried in the rear pockets of the fatigue trouser and the pockets closed. Attempting to carry more than two meals in the pockets of soldier's field clothing while operating with or without the standard load carrying equipment would seriously reduce the efficiency of the individual.

Data pertaining to the portability characteristics of both types of meals obtained during the field use phases are shown in Tables III and IV.

2. 3. 4 Analysis

Data show that the packaging is compatible with the pockets of field clothing when the meal is dispersed as individual components and that the soldier can satisfactorily carry a maximum of two meals in the pockets of his field clothing.

Examination of Table III shows that the majority of the test participants at Fort Polk found the space in their clothing and pack to be adequate when carrying 1, 2, or 3 meals of each type of rations. Data in Table IV show that the majority of the respondents at both Fort Polk and Fort Bragg stated that carrying the Meal, Ready-to-Eat, did not restrict their movements nor did it interfere to any great extent with their performance of field training tasks. At Fort Polk, where both types of meals were used and carried, the data show that restriction of movement was less when carrying the experimental Meal, Ready-to-Eat, than when carrying the standard Meal, Combat, Individual. Specifically, only 28.7 percent of the responses for the experimental meal showed restriction of movements as compared to 46.2 percent for the standard meal. Likewise, at Fort Polk there was less interference with the performance of field training tasks by soldiers when carrying the experimental meal than when carrying the standard meal. Responses to question 2b (Table IV) are general comments made by test participants and show that the major problem in carrying either meal is the bulkiness of the items. The responses show some adverse factors with regard to carrying the metal cans of the standard Meal, Combat, Individual.

Based on the data obtained during this and previous tests, the packaging of the Meal, Ready-to-Eat, Individual, is compatible with the pockets of field clothing when dispersed as individual menu components and meets the requirements of the Military Characteristics in this connection. Further, a 1-day supply (3 meals) of both the experimental and standard meals can be satisfactorily carried in the clothing and pack of the soldier while performing simulated combat tasks; however, the experimental meal is considered to be more suitable than the standard with regard to portability.

TABLE III

PORTABILITY - SUMMARY OF RESPONSES AS TO ADEQUACY
OF SPACE IN CLOTHING AND/OR PACK FOR CARRYING MEALS

Response	Advanced Infantry Training Cos. (Fort Polk)										Special Forces (Fort Bragg)*													
	Meal Ready-To-Eat					Meal, Combat, Ind					Meal Ready-To-Eat					Meal Ready-To-Eat								
	No. Meals Carried					No. Meals Carried					No. Meals Carried					No. Meals Carried								
	1		2		3	1		2		3	1		2		3	4		5		>5				
	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent	Per- Freq. cent			
More than Adequate	31	18.1	38	13.8	84	22.3	15	7.6	20	6.1	13	4.4	1	50.0	1	10.0	18	17.6	5	26.3	2	13.3	7	13.2
Adequate	122	71.3	206	74.9	251	66.6	148	74.7	231	70.9	196	66.9	1	50.0	8	80.0	78	76.5	13	68.4	13	86.7	41	77.4
Not Adequate	17	10.0	31	11.3	38	10.0	32	16.2	74	22.7	81	27.7	-	-	1	10.0	6	5.9	1	5.3	-	-	5	9.4
No Answer	1	.6	-	-	4	1.1	3	1.5	1	.3	3	1.0	-	-	-	-	-	-	-	-	-	-	-	-
Total	171	100	275	100	377	100	198	100	326	100	293	100	2	100	10	100	102	100	19	100	15	100	53	100

* Only the Meal, Ready-to-Eat was used. Personnel were equipped with rucksack.

TABLE IV

PORTABILITY - SUMMARY OF RESPONSES PERTAINING TO RESTRICTION OF MOVEMENT
AND INTERFERENCE WITH FIELD TRAINING TASKS WHEN CARRYING MEALS

Question	Response	Advanced Infantry Training Companies, (Ft. Polk)				Special Forces (Ft. Bragg)*	
		Meal Ready-to-Eat		Meal, Combat, Ind.		Meal Ready-to-Eat	
		Freq.	Per-cent	Freq.	Per-cent	Freq.	Percent
1. Did carrying meals in your clothing restrict your movement?	Yes, a great deal	26	3.0	81	9.5	6	2.9
	Yes, slightly	219	25.7	313	36.7	72	35.0
	No, did not restrict	576	67.5	392	46.8	123	59.7
	No answer	32	3.8	67	7.8	5	2.4
2. a. Did carrying meals interfere to any great extent with your performance of field training tasks?	Yes, a great deal	14	1.6	31	3.6	1	.5
	Yes, slightly	115	13.5	177	20.8	26	12.6
	No, did not interfere	696	81.6	591	69.3	174	84.5
	No answer	28	3.3	54	6.3	5	2.4
b. In what way did the carrying of meals interfere?	Bulky - restrict movement	35	49.3	51	43.2	12	57.2
	Heavy	8	11.3	16	13.6	2	9.5
	Difficult to bend	3	4.2	5	4.2	0	0
	Noisy	5	7.0	8	6.8	2	9.5
	Hurt body	0	0	19	16.1	0	0
	Insufficient space for all items	5	7.0	5	4.2	3	14.3
	Difficult to get into prone position	9	12.7	14	11.9	2	9.5
	Package burst in some positions	6	8.5	0	0	0	0

* Only Meal, Ready-to-Eat used.

2.4 DURABILITY

2.4.1 Objective

To determine the durability of packaging used with the Meal, Ready-to-Eat, Individual, and if adequate protection is provided to components.

2.4.2 Method

The determination of the durability of packaging for the experimental meal is based on results obtained under controlled conditions and reported in the previous Engineer Design Test and the Engineering Test of the Meal, Ready-to-Eat, Individual (App. IV, Ref. 2 and 3). Packaging materials and techniques used for components of the current meal are essentially the same as that for meals used in tests cited above. Furthermore, the components of the meal used in this test are similar to those used in previous tests and consisted of heat-processed, dehydrated, and conventional items such as baked goods. In general, the procedures used in the aforementioned tests involved the carrying of either one, two, or three meals dispersed in the pockets of clothing of soldiers while completing three traversals of selected obstacles of the USAGETA Design and Fabric Wear Course.

Throughout the current test, general observations were made by test team personnel regarding the durability and adequacy of the packaging.

2.4.3 Results

Reports of the previous tests of the Meal, Ready-to-Eat (App. IV, Ref. 2 and 3) showed the overall performance of the foods and packaging in the test on the accelerated wear course to be satisfactory. Treatment given these items during three traversals of the course obstacles, designed to provide maximum rather than normal stress, was considerably more harsh than any comparable type of treatment expected under normal field conditions. It was found that the dehydrated foods in their present packaging configuration were more susceptible to damage than other foods or items in the meals.

Observations made during the conduct of the current test showed no major problem or difficulty with the durability of the packaging of the meals and the overall performance was satisfactory.

2.4.4 Analysis

Based on previous reports and observations made during the current test, the packaging of the Meal, Ready-to-Eat, is durable and provides proper protection to the components.

2.5 WATER, INSECT, AND RODENT RESISTANCE

2.5.1 Objective

To determine the water, insect, and rodent resistance of the cases and packages of the Meal, Ready-to-Eat, Individual.

2.5.2 Method

Sixteen cases of meals were selected randomly from the shipment to Fort Lee and placed on the USAGETA Rain Course for exposure to a 1-inch per hour rainfall. Eight cases were placed on pallets and covered with a tarpaulin while the remaining eight were placed on the ground without any covering. One case from each test condition was withdrawn at 30-minute intervals and the case and contents were inspected by test team personnel for water penetration and damage. This procedure was continued for 4 hours, consequently the last cases were exposed to a total of 4 inches of rainfall. Observations and inspections were made by test team personnel during the Panama storage phase (Pars. 2.8 and 2.12) regarding the water, insect, and rodent resistance of cases and packages. Supplemental data pertaining to this objective were obtained from the U. S. Army Natick Laboratories and considered in determining the extent to which the test item meets the Military Characteristics.

2.5.3 Results

None of the eight cases and contents subjected to rainfall in the covered storage condition showed evidence of water penetration. With regard to cases in the uncovered storage, there was evidence of leakage at the seals and water penetration of the outer case for all cases after exposure of 1 hour. There was slight to moderate water penetration of the individual meal cartons but no damages to menu components were found since the waterproof packaging (overwrap) of the components prevented any water penetration.

Of 98 cases stored in a hot-wet environment in an uncovered - outside storage area in Panama (Par. 2.12), inspection after a 3-month

storage period showed evidence of heavy water penetration in 6 cases (Fig. 3). Although the outer cases were found to be in good condition, the individual meal cartons within these cases were in various states of disintegration and in no instance did the meal cartons appear to be sufficiently rigid for the retention of the components for further handling as individual meals. Individual menu components showed no evidence of water penetration and the packaging was generally intact. Some were covered with mold and slime but there was no evidence of damage or spoilage of the menu components which could be directly related to water penetration of the cases and meal cartons. In fact, the dehydrated foods, sugar, cream, coffee, and like items were dry and appeared to be in a normal condition.

With regard to the insect and rodent resistance of cases and packages, no major problem was observed. During the field use phases (Par. 2.7), two accessory packets were found to be heavily infested with *Oryzaephilus - Surinamensis*, commonly referred to as the saw tooth grain beetle. There were holes in the packaging of the accessory packets; however, it could not be determined if the holes were caused by the insects. Some evidence of insect infestation (ants and termites) was observed during the inspection of meals stored for 3 months in Panama with minor damage to meal cartons and components (Fig. 4). Minor evidence of damage to cases and meals by some type of unidentified gnawing animal was also observed during the Panama storage phase (Fig. 5). A summary of such damages is shown in Appendix I-R and paragraph 2.12.

2.5.4 Analysis

The water, insect, and rodent resistance of the meal case was found to be satisfactory in spite of some minor discrepancies. Since the packaging material and design in the meal case and sleeve of the experimental Meal, Ready-to-Eat, and the standard Meal, Combat, Individual, are essentially the same, the experimental meal is as good as the standard in this connection. Greater protection against water penetration could be provided by the use of a waterproof tape at the closure (seals) of the shipping cases. The fiberboard meal carton of the individual meals does not afford a great amount of protection against water, insects, and rodents but the individual menu components are protected from water penetration by the waterproof packaging so long as the integrity of the package is maintained. Since the components are packaged in flexible containers rather than metal cans, the packaging will not prevent penetration by boring-type insects and rodents. Investigations are being made by

Figure 3. Shipping case and meals damaged by water.

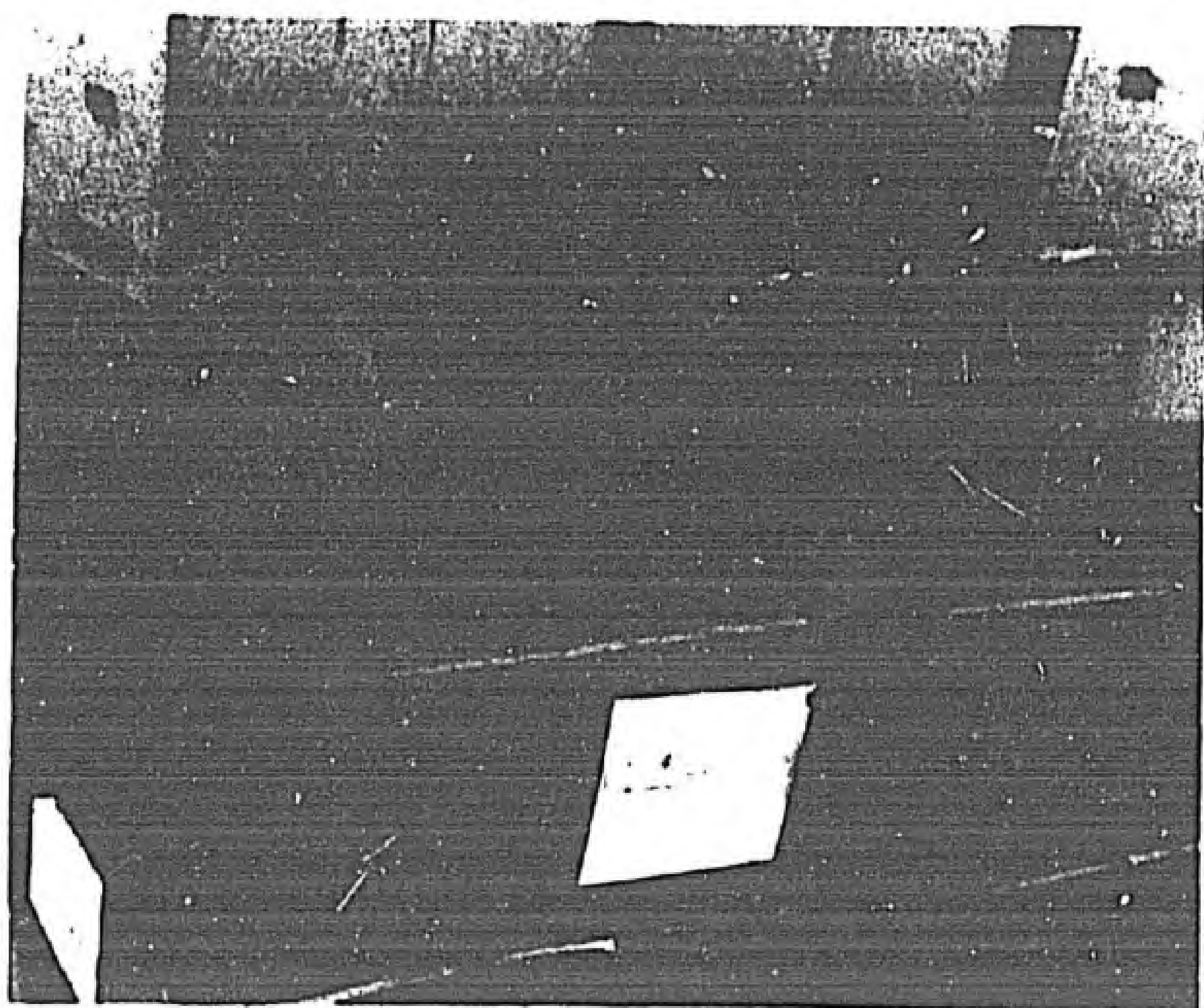
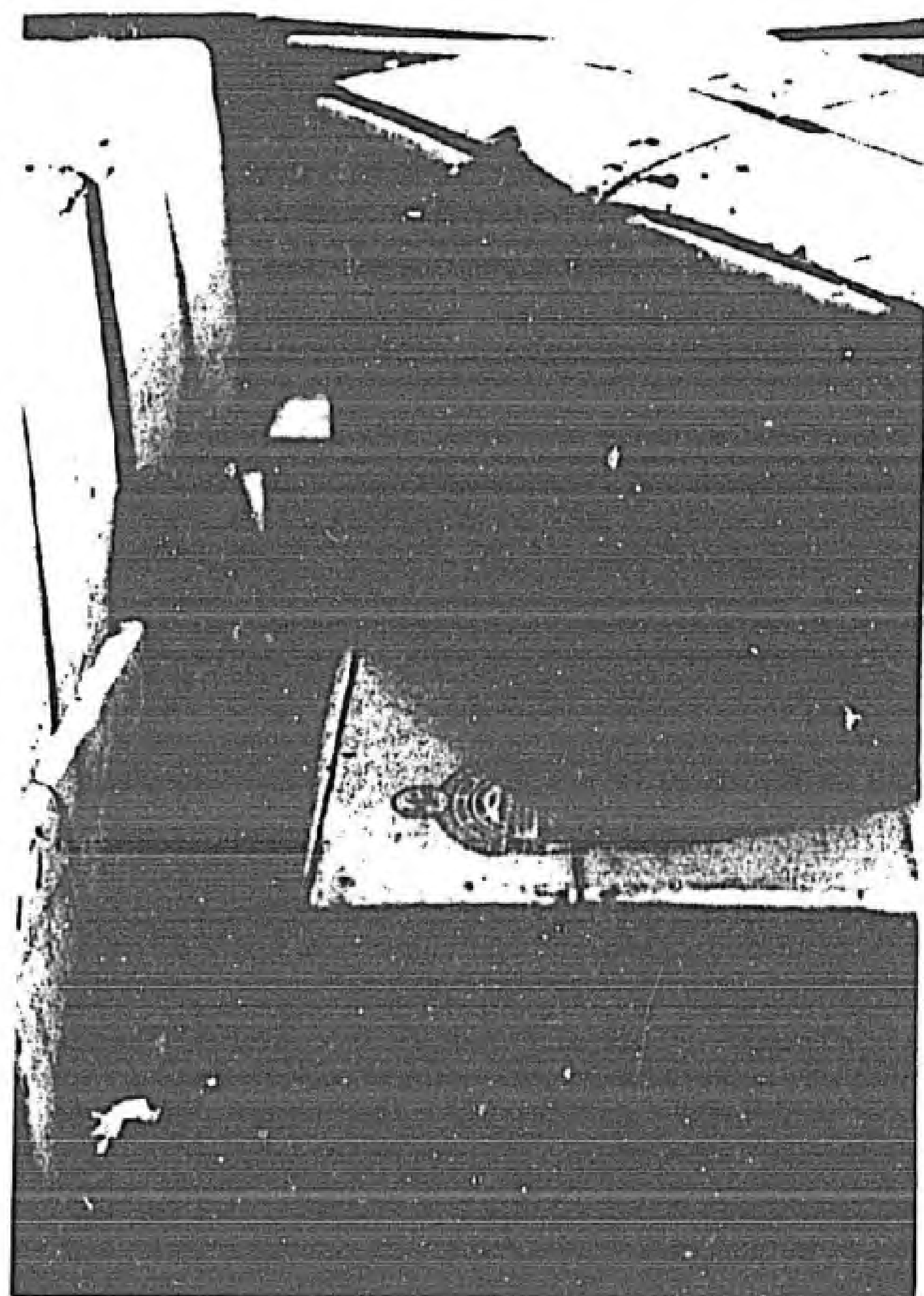


Figure 5. Meal case with hole gnawed into side (in Panama).

Figure 4. Meal cases showing termite tunnels on sides of cases.



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TECOM 8-3-7400-06/07/08

NEGATIVE 24P, 25P, 23P

the U. S. Army Natick Laboratories on the effectiveness of different treatments in providing greater protection.

The performance of the cases and packages of the Meal, Ready-to-Eat, was satisfactory and the item meets the requirements of the Military Characteristics pertaining to water, insect, and rodent resistance.

2.6 NUTRITIONAL ADEQUACY

2.6.1 Objective

To determine whether the Meal, Ready-to-Eat, provides daily nutritional requirements.

2.6.2 Method

Data pertaining to the nutritional analyses of each menu and components were obtained from the U. S. Army Natick Laboratories. These data were used in determining the extent to which the Meal, Ready-to-Eat, meets the minimum daily dietary requirements set forth in Appendix V, AR 40-5¹ and as referred to in the Military and Technical Characteristics.

2.6.3 Results

Required and actual values for nutrients of the meal, as stipulated in AR 40-5, are shown in Table V for each menu and combined across menus.

2.6.4 Analysis

Examination of Table V shows that, on an individual menu basis, the actual values for one or more nutrients for all menus except 11 and 12 to be slightly less than that required for one meal; i. e., one-third of the minimum daily requirements. Further, these data show that all menus are not essentially equivalent in all nutrients. However, the combined average nutritive value for all menus exceeds the minimum daily requirements. The Office of The Surgeon General reviewed data pertaining to the nutritional adequacy of the Meal, Ready-to-Eat, at the request of the U. S. Army Natick Laboratories and concurs that the experimental meal conforms to the requirements set forth in AR 40-5 and is nutritionally adequate

¹Previously AR 40-564

TABLE V

SUMMARY OF NUTRITIVE VALUES OF MEAL,
READY-TO-EAT MENUS AND COMBINED ACROSS MENUS

Menu	Calories (1200)*	Protein, gm (33) *	Calcium, mgm (233)*	Vitamin A, IU (1667) *	THIAMINE, mgm (.57)*	Riboflavin, mgm (.67)*	Niacin, mgm (5.3)*	Vitamin C, mgm (25)*
1	1275	43.4	228	2170	3.24	0.67	8.0	90
1a	1263	55.3	230	2260	2.20	0.75	9.2	95
2	1334	37.6	420	4520	0.68	0.68	5.3	18
3	1240	55.0	178	4560	0.99	0.71	14.9	59
4	1122	45.2	445	6910	1.18	1.35	9.5	59
4a	1365	61.8	209	7360	1.08	0.76	20.4	56
5	1191	47.5	174	3900	0.92	0.63	14.3	89
6	1215	29.3	416	2430	0.45	1.23	8.8	84
7	1259	41.3	352	1720	0.19	0.77	7.0	84
8	1234	44.0	82	3850	2.65	0.90	10.4	99
9	1287	34.8	151	80	0.27	0.60	5.5	16
10	1157	40.6	325	1790	1.75	0.75	6.6	61
11	1238	50.7	267	1920	1.42	1.33	13.3	45
12	1321	52.4	268	2720	0.97	1.34	9.3	58
Avg. for all Menus (W/164)	1239	43.5	276	3050	1.23	0.91	9.4	64
Avg for all Menus (W/1a54a)	1259	45.9	256	3090	1.13	0.87	10.4	64

* The numbers shown are one-third of the minimum daily requirements for the specified nutrients as listed in AR 40-5.

(App. IV, Ref. 13). Thus, the Meal, Ready-to-Eat, satisfactorily meets the requirements of the Military and Technical Characteristics in this connection.

2.7 PALATABILITY

2.7.1 Objective

To determine if the menus and components of the Meal, Ready-to-Eat, Individual, are acceptable when consumed hot or cold as a sole diet for periods up to and including 7 days and if the quantity of food in each meal is adequate.

2.7.2 Method

Four Advanced Infantry Companies, an Ordnance Company, three companies of an Engineer Battalion, Special Forces students and support personnel, and the Headquarters Company of a Supply and Service Battalion participated in this phase of the test while undergoing scheduled field training exercises. All testing was conducted during the period 9 October to 17 December 1966. Personnel of all units, except Special Forces, consumed both the experimental and standard meals approximately an equal number of times for periods up to and including 7 consecutive days. The Special Forces personnel consumed only the experimental meal for 9 consecutive days. The dates of pack for the standard and experimental meals were March and May 1966, respectively.

Both types of meals were consumed hot and cold at the discretion of the user and as the conditions permitted. When heated, the standard trioxane fuel bar was used as a heat source and the canteen cup was used as a water heating vessel (Fig. 6). Meals were issued randomly from both rations. For the experimental meal, an equal number of cases containing Menus 1 and 4 and Menus 1a and 4a were used.

After each mealtime, each test participant completed a food rating form on which he rated the menu and major components utilizing the 9-point hedonic scale (Fig. 7). Also, the individual marked each rating form to show whether major components were or were not heated prior to consumption; recorded the estimated plate waste for major components; and indicated whether the quantity of food in the meal was adequate.



Figure 6. Preparing and eating meal in the field.



Figure 7. Rating menu and components in the field.

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TECOM 8-3-7400-06/07/08

NEGATIVE 2HH, 7HH

2.7.3 Results

The average ratings for the experimental Meal, Ready-to-Eat, menus (hot and cold) by test sites, combined across test sites consuming both the experimental and standard meals, and combined across all test sites are shown in Tables VI and VII, respectively. Similarly, average ratings for the standard meal menus (hot and cold) by test sites and combined across all test sites are shown in Appendices I-C and I-D, respectively. Table VIII shows a comparison of the average rating for all Meal, Combat, Individual, menus combined and the average ratings for each menu of the Meal, Ready-to-Eat, when both rations were consumed hot and cold. The average hot and cold ratings for those components of the Meal, Ready-to-Eat, normally consumed hot are shown in Tables IX and X, respectively. Combined average ratings for comparable components of both rations which are normally consumed cold are shown in Table XI. The average ratings by day for the unit consuming both rations for 7 consecutive days to evaluate monotony effects are shown in Table XII. A comparison of the responses combined across test sites and units for the adequacy of the quantity of foods in both rations is shown in Table XIII. Responses pertaining to individual menus of the Meal, Ready-to-Eat, are summarized in Appendix I-E. The average percent of each major component of both rations consumed during the test, based on estimates of the amount of each food consumed as recorded by test participants at each mealtime, is shown in Appendix I-F. The most frequent comments made by test participants regarding both rations during this test phase are summarized in Appendices I-G and I-H. Weather summaries for the field use phases are shown in Appendix I-I.

2.7.4 Analysis

a. Menus

Examination of Tables VI, VII, and VIII and Appendices I-C and I-D shows a preference for the menus of the standard meal over the experimental meal when each ration was consumed both hot and cold by the same test units at Fort Polk, Camp Pickett, and Camp A. P. Hill. Table VIII shows that the difference in the average rating for the standard ration menus combined and the average rating for each menu of the experimental ration for units consuming both rations hot and cold, was statistically significant at the 5-percent probability level favoring the standard ration. While the experimental ration menus are less acceptable, the level of the average ratings for this ration, when consumed both hot and

TABLE VI

AVERAGE HEDONIC* RATINGS FOR MEAL, READY-TO-EAT MENUS

WHEN MAJOR COMPONENTS CONSUMED HOT

Menu	Fort Polk (Inf)			Fort Polk (Ord)			Camp Pickett (Sup & Svc Bn)			Camp AP Hill (Eng)			Polk, Pickett, & Hill Combined			Fort Bragg (Sp. Forces)			All Test Sites and Units Combined		
	No. Ratings	Avg. Rating		No. Ratings	Avg. Rating		No. Ratings	Avg. Rating		No. Ratings	Avg. Rating		No. Ratings	Avg. Rating		No. Ratings	Avg. Rating		No. Ratings	Avg. Rating	
1	57	5.54	32	6.22	10	5.90	91	6.12	190	5.95	151	7.42	341	6.60							
1a	48	5.96	35	6.06	8	6.50	18	6.39	109	6.10	54	7.00	163	6.40							
2	87	6.54	71	6.11	19	7.05	112	6.76	289	6.55	180	7.66	469	6.98							
3	111	6.14	80	6.21	17	6.53	100	6.28	308	6.22	147	7.01	455	6.48							
4	50	6.36	38	6.53	6	3.67	81	6.32	175	6.28	109	7.42	284	6.72							
4a	31	6.00	38	5.71	6	6.67	29	6.28	104	6.01	56	6.79	160	6.28							
5	98	6.44	58	6.38	17	7.18	111	6.66	284	6.56	167	7.66	451	6.97							
6	117	6.66	83	6.42	15	6.20	106	6.86	321	6.64	176	7.52	497	6.95							
7	104	6.22	93	6.33	20	6.50	109	6.32	326	6.30	162	7.50	488	6.70							
8	90	6.22	75	6.43	18	6.83	100	6.24	283	6.32	176	7.14	459	6.64							
9	89	6.89	82	6.18	20	5.40	113	6.40	304	6.42	174	7.40	478	6.78							
10	89	5.78	78	6.02	18	5.83	121	6.45	306	6.11	178	7.35	484	6.57							
11	113	6.15	81	6.33	16	6.69	120	6.31	330	6.28	165	7.27	495	6.61							
12	101	6.46	67	6.13	20	6.70	106	6.11	294	6.28	163	6.83	457	6.47							

* 9 - Like Extremely; 8 - Like Very Much; 7 - Like Moderately; 6 - Like Slightly; 5 - Neither Like nor Dislike; 4 - Dislike Slightly; 3 - Dislike Moderately; 2 - Dislike Very Much; 1 - Dislike Extremely

TABLE VII

AVERAGE HEDONIC RATINGS FOR MEAL, READY-TO-EAT
MENUS WHEN ALL COMPONENTS CONSUMED COLD

Menu	Fort Polk (Inf)		Fort Polk (Ord)		Camp Pickett (Sup & Svc Bn)		Camp AP Hill (Eng)		Polk, Pickett, & Hill Combined		Fort Bragg (Sp Forces)		All Test Sites and Units Combined	
	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating
1	110	5.93	13	6.00	4	5.50	17	4.65	144	5.81	48	6.81	192	6.03
1a	86	6.41	3	7.00	2	4.50	6	4.69	97	6.28	16	6.75	113	6.35
2	203	6.35	11	5.82	9	5.44	27	5.81	250	6.24	50	7.64	300	6.47
3	184	5.82	12	6.00	4	4.50	27	6.04	227	5.83	50	7.26	277	6.09
4	113	5.79	11	6.45	4	6.75	21	5.57	149	5.83	47	7.04	196	6.12
4a	98	6.11	2	5.00	3	5.67	5	6.20	108	6.08	13	7.31	121	6.21
5	199	6.51	9	7.11	3	7.67	31	6.23	247	6.51	51	7.24	293	6.64
6	174	6.46	12	5.83	5	5.40	21	5.19	212	6.32	46	7.43	258	6.48
7	190	6.43	11	6.54	3	7.33	23	6.30	227	6.43	52	7.04	279	6.55
8	195	6.29	7	5.28	6	6.67	32	5.75	240	6.20	39	6.87	279	6.29
9	201	6.56	16	5.81	6	3.67	26	6.46	249	6.43	46	7.39	295	6.58
10	186	6.17	16	6.56	3	2.00	29	5.07	234	6.00	34	7.29	268	6.17
11	182	6.46	5	6.20	6	6.33	27	4.96	220	6.26	40	7.10	260	6.39
12	217	5.93	12	5.17	3	4.67	26	5.54	258	5.84	50	7.16	308	6.05

TABLE VIII

**AVERAGE HEDONIC RATINGS FOR ALL MEAL, COMBAT, INDIVIDUAL MENUS
COMBINED AND AVERAGE RATINGS FOR SPECIFIC MEAL, READY-TO-EAT MENUS**

(When Major Components Consumed Both Hot and Cold)

Consumed	Meal, Combat, Ind. (All Menus Combined)*		Meal, Ready- to-Eat Menus	Polk, Pickett, and Hill Combined		Prob- ability Level**	Fort Bragg***	
	No. Ratings	Avg. Rating		No. Ratings	Avg. Rating		No. Ratings	Avg. Rating
Hot	3755	7.12	1	190	5.95	<.05	151	7.42
			1a	109	6.10	<.05	54	7.00
			2	289	6.55	<.05	180	7.66
			3	308	6.22	<.05	147	7.01
			4	175	6.28	<.05	109	7.42
			4a	104	6.01	<.05	56	6.79
			5	284	6.56	<.05	167	7.66
			6	321	6.64	<.05	176	7.52
			7	326	6.30	<.05	162	7.50
			8	283	6.32	<.05	176	7.14
			9	304	6.42	<.05	174	7.40
			10	306	6.11	<.05	178	7.35
			11	330	6.28	<.05	165	7.27
			12	294	6.28	<.05	163	6.83
Cold	2424	7.17	1	144	5.81	<.05	48	6.81
			1a	97	6.28	<.05	16	6.75
			2	250	6.24	<.05	50	7.64
			3	227	5.83	<.05	50	7.26
			4	149	5.83	<.05	47	7.04
			4a	108	6.08	<.05	13	7.31
			5	247	6.51	<.05	51	7.24
			6	212	6.32	<.05	46	7.43
			7	227	6.43	<.05	52	7.04
			8	240	6.20	<.05	39	6.87
			9	249	6.43	<.05	46	7.39
			10	234	6.00	<.05	34	7.29
			11	220	6.26	<.05	40	7.10
			12	258	5.84	<.05	50	7.16

*A combined average was used for the Meal, Combat, Individual, since menus of the two rations are not directly comparable.

**< The difference between ratings is significant at the 5-percent probability level.

***No statistical comparison made since Special Forces personnel consumed only the Meal, Ready-to-Eat.

TABLE IX

AVERAGE HEDONIC RATINGS FOR MAJOR COMPONENTS OF MEAL, READY-TO-EAT WHEN CONSUMED HOT

Component	Menu	Fort Polk (Inf)		Fort Polk (Ord)		Camp Pickett (Sup & Svc Bn)		Camp AP Hill (Eng)		Polk, Pickett, and Hill Comb.		Fort Bragg (Sp. Forces)		All Test Sites and Units Combined	
		No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating
Pork Pattie	1	46	6.24	33	6.15	10	5.80	90	6.27	179	6.21	154	7.45	333	6.79
Chicken Loaf	1a, 12	148	6.46	104	6.29	28	6.61	124	6.26	404	6.37	221	6.56	625	6.43
Beans w/Tomato Sauce	2, 4, 4a	170	6.78	144	6.02	34	6.94	212	6.72	560	6.57	343	7.31	903	6.85
Bacon	2	90	6.58	71	6.20	21	6.62	112	6.59	294	6.49	185	8.11	479	7.12
Ham & Chicken Loaf	3	110	6.39	80	6.31	17	7.12	99	6.64	306	6.49	151	6.78	457	6.59
Beef Pattie	4	50	6.04	38	6.39	6	3.50	82	6.11	176	6.06	111	7.33	287	6.55
Cocoa	4, 12	184	7.62	100	7.18	26	6.73	149	6.67	459	7.17	305	8.17	764	7.57
Beef Loaf	4a	32	5.75	39	5.77	6	6.17	28	6.36	105	5.94	57	6.49	162	6.14
Beef Slices w/BBQ	5	101	6.98	58	6.43	17	7.41	110	6.63	286	6.76	168	7.49	454	7.03
Potato Pattie	5, 7, 12	111	5.63	111	5.81	25	5.28	155	6.08	402	5.83	281	7.46	683	6.50
Chicken ala King	6	119	6.84	83	6.76	16	6.44	106	7.01	324	6.86	177	7.96	501	7.25
Gr. Beef in Sauce	7	105	6.60	93	6.50	20	6.75	107	6.67	325	6.60	160	7.59	485	6.93
Beef Stew	8	94	6.98	75	6.71	18	7.44	99	6.61	286	6.81	176	7.38	462	7.03
Frankfurter	9	89	7.08	82	6.34	20	5.85	112	6.67	303	6.65	177	7.56	480	6.98
Coffee	all	264	7.08	130	6.40	28	5.61	162	6.25	584	6.63	318	7.63	902	6.98
Pork Sausage Links	10	92	6.66	80	6.32	18	7.11	121	6.97	311	6.72	181	7.79	492	7.11
Beefsteak	11	115	6.14	83	6.38	16	7.12	120	6.33	334	6.31	163	7.31	497	6.64

TABLE X

AVERAGE HEDONIC RATINGS FOR MAJOR COMPONENTS OF MEAL, READY-TO-EAT WHEN CONSUMED COLD

Component	Menu	Fort Polk (Inf.)		Port Polk (Ord)		Camp Pickett (Sup & Svc En)		Camp AP Hill (Eng)		Polk, Pickett, and Hill Comb.		Fort Bragg (Sp. Forces)		All Test Sites and Units Combined	
		No.	Avg. Rating	No.	Avg. Rating	No.	Avg. Rating	No.	Avg. Rating	No.	Avg. Rating	No.	Avg. Rating	No.	Avg. Rating
Pork Pattie	1	110	5.66	13	6.23	4	5.00	17	4.58	144	5.57	48	6.42	192	5.78
Chicken Loaf	1a, 12	305	6.25	15	5.60	5	6.40	32	5.88	337	6.19	66	6.56	423	6.25
Beans w/Tomato Sauce	2, 4, 4a	409	6.57	23	5.57	15	6.93	55	6.33	502	6.51	109	7.34	611	6.66
Bacon	2	201	6.23	6	5.50	5	4.75	26	6.15	238	6.17	43	7.35	281	6.35
Ham and Chicken Loaf	3	182	5.99	12	6.33	4	4.75	27	6.07	225	6.00	52	7.02	277	6.19
Beef Pattie	4	112	5.37	9	5.56	4	6.00	20	4.50	145	5.28	47	6.38	192	5.55
Cocoa	4, 12	213	6.56	10	6.20	6	6.17	36	6.11	265	6.48	45	7.76	310	6.66
Beef Loaf	4a	99	5.86	2	5.00	3	6.00	5	6.80	109	5.89	14	6.71	123	5.98
Beef Slices w/BBQ	5	199	6.64	9	6.78	3	8.33	30	6.37	241	6.63	53	7.17	294	6.73
Potato Pattie	5, 7, 12	437	5.59	67	5.69	16	6.81	94	6.26	614	5.74	143	6.71	757	5.92
Chicken ala King	6	174	6.75	12	5.58	5	5.80	21	5.38	212	6.53	46	7.33	258	6.67
Gr. Beef in Sauce	7	193	6.64	10	6.40	3	7.67	23	5.83	229	6.56	53	6.92	282	6.63
Beef Stew	8	196	6.58	7	5.71	6	7.17	32	5.72	241	6.46	39	6.82	280	6.51
Frankfurter	9	203	6.92	16	6.00	6	4.67	25	6.76	250	6.79	47	7.36	297	6.88
Coffee	all	126	6.46	5	6.80	5	6.50	26	5.58	162	6.33	24	7.08	186	6.43
Pork Sausage Links	10	189	6.50	15	6.27	3	3.00	29	5.38	236	6.30	34	7.18	270	6.41
Beefsteak	11	185	6.55	5	5.40	6	6.00	27	5.70	223	6.41	41	6.90	264	6.48

TABLE XI

AVERAGE RATINGS FOR COMPARABLE COMPONENTS INCLUDED IN
MEAL, READY-TO-EAT AND MEAL, COMBAT, INDIVIDUAL
WHICH ARE NORMALLY CONSUMED COLD

(Based On Data From All Test Units Combined)

Component	Meal, Ready-to-Eat		Meal, Combat, Individual	
	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating
Date Pudding	813	5.55	505	6.51
Cheese	1537	5.96	2084	6.31
Apricot Cereal Bar	834	4.61	N/A	
Chocolate Candy Bar	1648	7.07	N/A	
Cookies	1625	7.51	1759	7.59
Peanut Butter	1040	6.84	2102	6.88
Chocolate Nut Roll	765	5.35	N/A	
Crackers	1634	6.87	1095	6.86
Vanilla Candy Bar	801	6.91	514	6.88
Pound Cake	809	5.75	546	7.09
Orange Cereal Bar	1556	4.47	N/A	
Bread	1137	5.24	1675	6.53
Chocolate Covered Brownies	821	6.79	N/A	
Fruitcake	802	6.02	550	6.98
Jelly	1539	7.27	N/A	
Jam	N/A		1128	7.34
Raisin Nut Cake	300	5.77	N/A	
Pecan Roll	N/A		504	6.75
Orange Nut Roll	789	5.58	N/A	
Fruit Cocktail	N/A		405	7.90
Peaches	898	6.73	419	8.19
Apricots	538	6.36	389	7.63
Pears	125	5.97	437	7.80
Strawberries	605	7.41	N/A	
Pineapple	430	7.77	N/A	

TABLE XII

AVERAGE RATINGS BY TEST DAY FOR MEAL,
READY-TO-EAT AND MEAL, COMBAT,
INDIVIDUAL FOR 7 CONSECUTIVE DAYS
(Monotony Effects)

(Based on Test Data of One Unit)

Day	Meal, Ready-to-Eat		Meal, Combat, Individual	
	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating
1	169	5.98	167	6.83
2	193	6.22	217	6.85
3	189	6.33	207	6.87
4	180	6.42	190	7.00
5	181	5.91	183	6.85
6	100	6.32	107	6.73
7	98	6.40	86	6.90

TABLE XIII

ADEQUACY OF QUANTITY OF FOOD IN MEAL,
READY-TO-EAT AND MEAL, COMBAT, INDIVIDUAL MENUS

(Based on Data From all Test Units Combined)

Responses	Response Distribution			
	Meal, Ready-to-Eat		Meal, Combat, Individual	
	No. Responses	Percent	No. Responses	Percent
More than enough	380	3.8	253	3.7
Enough	5,682	56.4	4,190	60.8
Not enough	3,769	37.4	2,293	33.3
No answer	238	2.4	153	2.2
TOTAL	10,069	100	6,889	100

cold, was sufficiently high for all menus to be considered acceptable from a palatability standpoint. However, it should be pointed out that for those units consuming both rations, the level of the average ratings for Menus No. 1 (hot) and Menus Nos. 1, 3, 4, and 12 (cold) of the experimental ration was barely sufficient to be considered acceptable. Special Forces personnel, which consumed only the experimental ration, consistently rated it higher than did test units using both rations. Table VIII shows the average ratings by Special Forces personnel for each menu of the experimental ration to be approximately equal to that for the average rating for the standard ration menus combined. This relatively high rating for the experimental ration is generally attributed to the overall favorable attitude of Special Forces personnel toward flexibly packaged foods in the field use phase reported herein and in paragraph 2.10, as well as that exhibited in previous tests.

b. Foods

Examination of the ratings for major components of the experimental meal (Tables IX and X) shows, in general, a close relationship between the average ratings of these components and the menus in which they are included (Table VIII). Since the major components were items normally consumed hot, there was a greater difference between the hot and cold ratings for components than there was for the menus. This trend was found in all units including Special Forces. Major components showing the greatest decrease in average ratings when consumed cold were: pork pattie (1.01), beef pattie (1.00), cocoa (.91), bacon (.77), and pork sausage links (.70). Examination of the average ratings (Table XI), for comparable components included in both rations which are normally consumed cold, shows substantial differences between the average ratings for all baked items (bread and cakes) with the components of the standard ration being preferred. Likewise, there was a substantial difference between the average ratings for the dehydrated fruits of the experimental ration and the wet-pack fruits of the standard ration with the standard ration components being preferred. The bread, at its best, was of poor quality and a considerable amount was found to be moldy when the package was opened by the test participants, which no doubt had an undetermined adverse effect on the soldier's attitude toward the experimental ration in general. One of the main objections to the cake items of the experimental ration was the outer covering of the items which was generally described by test participants as a "wax coating." The relatively low consumption rate of the cake components, as well as bread, as shown in Appendix I-F further

substantiates that these items were not too well liked by the soldier. The levels of the average ratings for bread (5.24) and chocolate nut roll (5.35) are just slightly above the neutral point on the rating scale and these items are considered marginally acceptable from a palatability standpoint. This is a shortcoming. The main objections to the dehydrated fruits were problems experienced in the proper rehydration of items and the feeling of the test participants that a lesser quantity of fruit, and fruit of an inferior quality, when rehydrated, were provided in the experimental ration than was provided in the standard ration. It is noted that the average ratings for the wet-pack pineapple of the Meal, Ready-to-Eat, compared favorably with the average ratings for the wet-pack fruits of the Meal, Combat, Individual.

The average ratings for the apricot and orange cereal bar were 4.61 and 4.47, respectively, which are below the neutral point on the rating scale and these items are considered unacceptable from a palatability standpoint. This is a shortcoming. A further indication that both cereal bars were unacceptable was the low overall consumption rate of 57 and 69 percent, respectively, for these items as shown in Appendix I-F. It was noted in the previous test of this ration (App. IV, Ref. 2) that cereal bars were also rated as one of the least acceptable components. In view of consistent low ratings for cereal bars, it appears that the item should be replaced with an item which will be acceptable to the soldier.

c. Monotony

The average ratings by test day in Table XII shows no systematic trend or decrease with continued consumption both hot and cold over a 7-day period for either the experimental or standard rations. This indicates that the menus and foods of both rations were generally as acceptable on the last day of the test as they were initially. Further, the level of the average ratings shows the experimental ration is acceptable when consumed for 7 days although not as acceptable as the standard ration.

No recorded adverse comments were received with regard to variety except that the experimental meal should contain a flavored cold drink base. Voluntary comments received from test participants during the field use phase suggest that an excess of chocolate items are included in the menus (chocolate-covered cookies, brownies, and vanilla candy bars, and chocolate fudge candy bars, chocolate candy bars w/ almonds, and chocolate nut rolls).

d. Quantitative Adequacy of Menus

Examination of Table XIII shows that the majority of the test participants responded that an adequate quantity of food was provided in both meals. As shown in Table XIII, the fact that respondents felt the experimental meal was not as adequate as the standard meal was partly due to the relatively low acceptability and low consumption of certain components of the experimental meal, especially the baked items and cereal bars (App. I-F). The consumption rates for peanut butter and cheese spread were also low; however, these items were rated as acceptable and the low consumption was due to the individual packages containing a greater quantity of these items than the individual could consume at one mealtime. This indicates that the quantity of peanut butter or cheese spread per package is excessive and should be reduced to eliminate food waste, with appropriate supplements added to insure nutritional adequacy of the meal. Menu No. 6 was rated as being the least adequate of all individual menus.

e. General

Overall, the experimental Meal, Ready-to-Eat, was not as acceptable as the standard Meal, Combat, Individual, when consumed both hot and cold; however, the level of the average rating for each menu of the experimental ration was sufficiently high to be considered acceptable from a palatability standpoint. The levels of the average ratings for components of the experimental meal are sufficiently high for all components to be considered acceptable except for bread, chocolate nut roll, and apricot and orange cereal bars. In addition to the dehydrated fruits being less acceptable than the wet-pack fruits of the standard ration per se, the adverse changes in the rehydration qualities of the dehydrated fruits resulting from exposure to temperatures of 100°F. or above as observed during this test (Par. 2. 12) will tend to further decrease the acceptability of these items. Although the menus and the majority of the components of the Meal, Ready-to-Eat, are acceptable, improvements in the palatability of the ration are necessary to assure a higher consumption rate than was experienced in this test, thus providing the soldier with an adequate quantity of acceptable food and nutritionally adequate meals. The Meal, Ready-to-Eat, meets the requirements of the Military and Technical Characteristics pertaining to acceptability and adequate quantity of foods.

2.8 TRANSPORTATION AND HANDLING

2.8.1 Objective

To determine the capability of the Meal, Ready-to-Eat, menus in the shipping case to withstand handling during transportation and storage prior to use and its suitability for transport.

2.8.2 Method

Arrangements were made by USAGETA for the initial shipment (4,165 cases) of the test item from the point of assembly (Kansas City, Missouri) in specified quantities to the General Equipment Test Activity, Fort Lee, Virginia; the Infantry Board, Fort Benning, Georgia; and the Airborne, Electronics and Special Warfare Board, Fort Bragg, North Carolina. Methods of transportation used for these shipments were commercial airfreight, rail freight, and motor freight. Upon arrival of the shipments at Forts Lee and Benning, a visual inspection was made of each case and all cases that showed evidence of damage were withdrawn for a detailed inspection of their contents. In addition, 20 cases from each of the motor and rail shipment and 10 cases from the air shipment were selected randomly and a 100-percent damage analysis was made on these cases and contents.

Subsequent shipments of meals initially received at Fort Lee were made by motor freight or military truck to Fort Polk, Louisiana; Fort Bragg, North Carolina; and Camps Pickett and A. P. Hill, Virginia, for use in the field use phase of the test (Par. 2.7). Upon arrival at the above installations, the meals were off-loaded and stored in warehouses with subsequent delivery by military truck to the troops in the field. Records were made of any observed damage.

Sixteen hundred cases were prepared for shipment by the Infantry Board and shipped from Fort Benning by motor freight to New Orleans, Louisiana, and then trans-shipment by surface transportation to Panama for 3 months storage (Par. 2.12). One-half of the shipment was made as individual cases while the remainder of the cases were palletized into 13 unit loads in accordance with MIL-L-35078: "Preparation of Nonperishable Subsistence in Unit Loads." Evaluations as to the condition of the cases and palletized unit loads were made prior to shipment from Fort Benning, at each trans-shipment point, and upon arrival at the storage area in Panama. Cases and unit loads showing evidence of damage

sufficient to indicate that contents had been damaged were withdrawn, opened, and inspected. In addition, 100 undamaged cases were selected from the loose cases and the palletized unit loads and a 100-percent inspection was accomplished.

2.8.3 Results

Examination of all cases in the initial shipment to Fort Lee and Fort Benning showed no evidence of damage of any practical importance to the shipping cases. Damages and failures of components found during the 100-percent inspection of meals in connection with the shipping and handling phases and the related safety inspection are summarized in Tables XIV and XV. A detailed breakdown of these damages and failures are shown in Appendix I-J. The criteria used for judging damage and failure of components are defined and shown in Appendix I-K. Inspection of the individual cases and the palletized unit loads of the Panama shipment at New Orleans and upon arrival in Panama showed no damages to the cases or unit loads of any practical importance. Evaluation of the unit loads after a 3-month storage period are shown in Appendix I-L.

2.8.4 Analysis

The damages and failures shown in Tables XIV and XV were those found when the packages were inspected upon completion of the shipping and handling phases. To identify or classify these damages and failures as resulting from shipping and handling would be improper since it appeared that many of the discrepancies resulted from faulty processing. For example, the moldy items (baked products, primarily bread) and the defective seals of the meat items obviously resulted from faulty processing or assembling of the components rather than from shipment.

Observations made during all phases of the test showed that cases and packages were marked to show essential information and all markings remained legible under all conditions encountered in storage, transport, and distribution. Further, observations showed that the experimental Meal, Ready-to-Eat, was suitable for all means of transportation to include rail, air (Par. 2.9), motor vehicles both military and commercial, and by the individual soldier.

The performance of the shipping cases and packages from a shipping and handling standpoint was considered excellent. This is borne

TABLE XIV

SUMMARY OF FAILURES BY TYPE FOR
DRY-PACK COMPONENTS

(See Appendix I-J-1)

(Based on Examination* of 71,779 Individual Packages Which Included
Baked Items; Dehydrated Meats, Potatoes, and Fruits; and Cereal Bars)

<u>Type of Failure</u>	<u>Number</u>
Moldy	228
Defective Seal	10
Dirty Package	5
Pinhole in packaging	2
Cut package	1
Total	251
Overall Percent	.35

*Includes items found during initial inspections and items turned in by
test participants during field use phases.

TABLE XV

SUMMARY OF FAILURES BY TYPE FOR
WET-PACK COMPONENTS

(See Appendix I-J-2)

(Based on Examination of 53,085 Individual Packages Which Included
All Wet-Pack Meat Items, Fruit, and Spreads)

<u>Type of Failure</u>	<u>Number</u>
Seal Failure (Leakage)	84
Wall Failure (Leakage)	52
Sweller (Gas Formation)	7
Defective Seal	6
Dirty Package	3
Pinhole in Packaging	2
Cut Package	2
Delaminated Pouch	1
TOTAL	157
Overall Percent	.30

out by the low overall percent of damage and failure of components, as shown in Tables XIV and XV of 0.30 and 0.35, respectively, which included damage or failures due to both shipping hazards and preshipment processing. This is further borne out by the excellent performance of the individual cases and unit loads in the Panama shipment. The low failure rate for the individual components and the absence of any reportable damage to shipping cases show that the Meal, Ready-to-Eat, container system is highly satisfactory from the standpoint of transportation and handling and that it meets the requirements of pertinent Military Characteristics.

2.9 AIR DELIVERY

Airdrop testing of the Meal, Ready-to-Eat, Individual, in shipping containers, was conducted at Fort Bragg, North Carolina by the U. S. Army Airborne, Electronics and Special Warfare Board during the period 7 through 10 June 1966. The test item was airdropped utilizing standard low velocity, high velocity, and freedrop techniques, and utilizing U. S. Air Force C-130 and U. S. Army CV-7 aircraft. Technical inspection of the test items after airdrops were conducted at Fort Bragg by personnel of the U. S. Army General Equipment Test Activity and resulting data provided the USAAESWBD. Motion and still pictures were taken and analyzed.

2.9.1 Test No. 1 - Airdrop by Parachute

2.9.1.1 Objective. To determine the suitability of the test item for airdrop by parachute based on the following criterion: cases in which the test items are shipped shall be capable of aerial delivery by parachute.

2.9.1.2 Method.

a. Fifty cases were rigged in a Bag, Cargo, A-22 and airdropped utilizing a G-12D Parachute from a CV-7 aircraft flying at 110 knots indicated air speed and 500 feet absolute altitude. Two layers of standard pad, energy dissipating, honeycomb, were placed under the cases.

b. Twelve cases were rigged in a Bag, Cargo, A-21 and airdropped utilizing a G-13 Parachute from a CV-7 aircraft flying at 110 knots indicated air speed and 1,250 feet absolute altitude. One layer of standard pad, energy dissipating, honeycomb, was placed under the cases.

c. One-hundred cases were rigged on an 8-foot modular airdrop platform and airdropped utilizing a G-11A parachute from a C-130 aircraft flying at 130 knots indicated air speed and 1,500 feet absolute altitude. Two layers of standard pad, energy dissipating, honeycomb, were placed under the cases.

d. Twelve cases were rigged in a Bag, Cargo, A-21, and airdropped from a C-130 aircraft flying at 130 knots indicated air speed and 400 feet absolute altitude. One layer of standard pad, energy dissipating, honeycomb, was placed under the cases. Three 68-inch pilot parachutes were utilized to stabilize the load.

e. Loads were derigged after each drop and inspected for damage. Each case was given a visual inspection of the exterior, and selected cases from each load were opened and inspection of the contents was made.

2.9.1.3 Results.

a. The test item was satisfactorily airdropped utilizing the methods described in paragraphs 2.9.1.2a, b, and c. Inspection after each airdrop indicated that no damage was sustained.

b. The test item was satisfactorily airdropped utilizing the high velocity technique described in paragraph 2.9.1.2d. Inspection and evaluation indicated 2.9 percent damage in the moderate and heavy failure categories (App. I-M). Failures within these categories were considered to be damaged which would render the item unsuitable for use.

2.9.1.4 Analysis. Test criterion was met. Since the Military Characteristics does not specify a percent recovery rate for aerial delivery with parachute, the failure rate incurred during high velocity delivery is considered to be negligible.

2.9.2 Test No. 2 - Airdrop Without Parachute

2.9.2.1 Objective. To determine the suitability of the test item for airdrop without parachute based on the following criterion: Cases in which the test items are shipped shall be capable of aerial delivery without a parachute with assurance of 75 percent recovery.

2.9.2.2 Method

a. Twelve cases were airdropped singly from a CV-7 aircraft flying at 110 knots indicated air speed and 150 feet absolute altitude. No pad, energy dissipating, honeycomb, was utilized.

b. Four cases were lashed together with Slings, Cargo, A-7A, and free dropped from a CV-7 aircraft flying at 110 knots indicated air speed and 150 feet absolute altitude. No pad, energy dissipating, honeycomb, was utilized.

c. Four cases were lashed together with Slings, Cargo, A-7A, and free dropped from a CV-7 aircraft flying at 110 knots indicated air speed and 150 feet absolute altitude. One layer of pad, energy dissipating, honeycomb, was placed around and between the cases.

d. Inspection was made of the test items after each drop. Each case was opened and each item was examined for damage and the results were recorded.

2.9.2.3 Results. Inspections and evaluations conducted after the airdrops shown in paragraph 2.9.2.2 a, b, and c above, indicated a 23.5, 29.4, and 5.9 percent damage, respectively, to components (App. I-N, I-O, I-P, respectively). Damages reflected in the above percentages were in the moderate and heavy failure categories. Failures within these categories were considered to be damages which would render the item unsuitable for use.

2.9.2.4 Analysis

a. The recovery rate of the test item when free dropped by the method in paragraph 2.9.2.2a meets the test criterion.

b. The test item when dropped by the method in paragraph 2.9.2.2b does not meet the test criterion.

c. The test item when free dropped by the method in paragraph 2.9.2.2c meets the test criterion.

d. In general, high failure rates were experienced in the individual wet-pack items with high liquid content.

e. Based on the above, the Meal, Ready-to-Eat, meets the requirements of the Military Characteristics with regard to aerial delivery except when airdropped without parachute with cases lashed together and without pad, energy dissipating, honeycomb. This method of airdrop should therefore not be used as there are other suitable methods available.

2. 10 GENERAL COMMAND AND TROOP ACCEPTANCE

2. 10. 1 Objective

To obtain an overall evaluation of the Meal, Ready-to-Eat, Individual, by command personnel and troops.

2. 10. 2 Method

a. All units except Special Forces.

Near the end of the field use phases after experience with both the experimental and standard meals (Par. 2. 7), commanders and subordinate leaders down to and including squad leaders completed a questionnaire in which they evaluated the relative suitability of the experimental and standard meals from a command standpoint. Similarly, a questionnaire was completed by all personnel in which they evaluated the relative suitability of the experimental and standard meals from a user standpoint.

b. Special Forces.

Since Special Forces used only the Meal, Ready-to-Eat, during this test, personnel completed a questionnaire near the end of the field use phase (Par. 2. 7) in which they evaluated the meal from a user standpoint.

2. 10. 3 Results

a. Responses of command personnel to specific questions pertaining to the overall effect on the capabilities of the units and the suitability of both meals from a command standpoint are summarized in Table XVI.

TABLE XVI

SUMMARY OF RESPONSES TO COMMAND ACCEPTANCE QUESTIONNAIRE

(Based on Data from All Test Units Except Special Forces)

RESPONSE	Frequency			
	Meal, Ready-to-Eat		Meal, Combat, Ind	
	Total	Percent	Total	Percent
1. Effect on mobility:				
Increased	59	36.2	37	22.7
Decreased	26	16.0	28	17.2
No appreciable change	62	38.0	69	42.3
No answer	16	9.8	29	17.8
2. Effect on Morale:				
A boost to morale	23	14.1	52	31.9
Detrimental to morale	53	32.5	8	4.9
No appreciable change	68	41.7	71	43.6
No answer	19	11.7	32	19.6
3. Effect on feeding of unit:				
Easier	53	32.5	75	46.0
More difficult	62	38.0	17	10.4
No appreciable difference	40	24.6	48	29.5
No answer	8	4.9	23	14.1
4. Effect on ability to accomplish mission:				
Increased	28	17.2	41	25.2
Decreased	38	23.3	9	5.5
No appreciable difference	75	46.0	74	45.4
No answer	22	13.5	39	23.9
5. Problem in distribution of meal:				
Yes	21	12.9	5	3.1
No	135	82.8	146	89.6
No Answer	7	4.3	12	7.3
6. Overall Suitability:				
Very Suitable (5)	35	21.5	62	38.0
Moderately suitable (4)	66	40.5	69	42.3
Neither suitable nor unsuitable (3)	16	9.8	16	9.8
Moderately unsuitable (2)	28	17.2	5	3.1
Very unsuitable (1)	14	8.6	4	2.4
No answer	4	2.4	7	4.4
Average rating	3.50	N/A	4.15	N/A

b. Responses of personnel of participating units pertaining to the overall adequacy of Trioxane fuel bars for the heating of meals, ease of opening and eating from packages of the experimental meal with comments as to any difficulties or foods involved, specific likes and dislikes or problems, and overall suitability ratings for both meals from a user standpoint, as appropriate, are summarized in Tables XVII, XVIII, and XIX.

2.10.4 Analysis

Data shown in Table XVI indicate that the standard meal was significantly (5-percent probability level) more suitable than the experimental meal from a command standpoint on the effects of morale, ease of feeding troops, and ability of the unit to accomplish its mission. In contrast, the experimental meal was significantly (5-percent probability level) more suitable than the standard with regard to effects on mobility. Responses to the distribution of meals show that the vast majority had no problem with either the experimental or standard item. In evaluating the overall suitability of the two meals for use by the unit, the command personnel consistently rated the standard meal higher than the experimental meal and the difference in the distribution of the responses for the standard and experimental meals was statistically significant at the 5-percent probability level. The level of the average rating shows that the command personnel felt the standard meal was suitable for use by the unit. On the other hand, the level of the average rating for the experimental meal was midway between the moderately suitable and the neutral categories on the rating scale which indicates that it was marginally suitable for use by the unit. The major criticisms of the command personnel regarding the canteen cup concept for heating the Meal, Ready-to-Eat, were that it took too much time and required too much water; however, the overall reaction generally indicated that the concept was satisfactory.

Data in Table XVII show that a substantial majority of the respondents found the trioxane fuel bar satisfactory for heating both the experimental and standard meals; however, the performance of the fuel bar with the standard meal was found to be more satisfactory than with the experimental meal. Although the issue factor for fuel bars during this test was greater than that normally stipulated, the majority of the comments pertinent to insufficient heat (fuel bars do not last long enough - not enough fuel bars) for the proper preparation of food items. The quantity of fuel bars required in heating meals will vary depending on environmental conditions and related factors; however, it is obvious that the

TABLE XVII

GENERAL TROOP ACCEPTANCE - SUMMARY OF RESPONSES TO GENERAL SUITABILITY QUESTIONS PERTAINING TO HEATING OF MEALS

QUESTION	RESPONSE	Test sites using both Meal, Ready-to-Eat (MRE) & Meal, Combat, Individual (MCI)												TOTAL		Meal, Ready to-Eat only Fort Bragg (Sp Forces)
		Fort Polk (Inf)		Fort Polk (Ord)		Camp Pickett (Sup & Svc Bn)		Camp AP Hill (Eng)								
		MRE	MCI	MRE	MCI	MRE	MCI	MRE	MCI	MRE	MCI	MRE	MCI			
1. Were fuel bars satisfactory or unsatisfactory?	Satisfactory	626	709	24	54	53	69	200	198	903	1030			134		
	Unsatisfactory	209	122	52	22	23	7	81	71	365	222			61		
	No answer	18	22	0	0	0	0	64	76	82	98			11		
2. Problems encountered in heating of both MRE & MCI meals.	Fuel bars do not last long enough	90		15			43		8		156			36		
	Not enough bars	111		21			4		2		138			18		
	Not enough time	66		2			9		8		85			14		
	Time required to heat MRE too long	33		0			23		9		65			0		
	MRE hard to heat	17		9			7		6		39			1		
	Rain	3		0			0		0		3			27		
	Food would not heat evenly	11		1			2		0		14			1		
	Fume from bar is offensive	3		6			4		5		18			3		
	Hard to get right mixture of food and water	4		1			2		1		8			0		
	Too much water to be heated with MRE	13		0			10		4		27			0		
	MCI takes longer to heat	6		0			3		1		10			NA		

TABLE XVIII

**GENERAL TROOP ACCEPTANCE - SUMMARY OF RESPONSES TO GENERAL SUITABILITY QUESTIONS
PERTAINING TO EASE OF OPENING AND EATING FROM PACKAGES OF THE MEAL,
READY-TO-EAT, INDIVIDUAL**

QUESTION	RESPONSE	Fort Polk (Inf.)	Fort Polk (Ord.)	Camp Pickett (Sup & Svc Bn)	Camp AP Hill (Eng.)	Fort Bragg (Sp. Forces)	Total	Percent
1. Did you consider the packages easy or difficult to open?	Very easy	(4) 197	2	9	44	67	319	20.5
	Slightly easy	(3) 245	10	19	116	63	453	29.1
	Slightly difficult	(2) 318	39	33	142	66	598	38.4
	Very difficult	(1) 87	24	14	35	8	168	10.8
	No answer	6	1	1	8	2	18	1.2
2 a. Did you have any difficulty eating foods directly from the packages?	Average	2.65	1.87	2.31	2.50	2.93	2.60	----
	Yes	214	27	20	123	31	415	26.7
	No	631	48	55	220	171	1125	72.3
	No answer	8	1	1	2	4	16	1.0
	Spoon not long enough	62	9	52	4	15	142	46.7
b. What were the difficulties and which foods were involved?	Messy	18	3	2	6	4	33	10.8
	Packaging bends or folds	7	0	6	4	2	19	6.2
	Some foods too dry	15	1	0	2	1	19	6.2
	Packages hard to hold	0	5	3	8	0	16	5.3
	Hard to get food out of packaging	0	0	0	5	0	5	1.7
	Hands cold	6	0	0	2	0	8	2.6
	All foods	10	1	0	13	0	24	7.9
	Greasy foods	6	1	1	1	2	11	3.6
	Fruit	8	2	0	1	0	11	3.6
	Sauces	5	0	0	0	1	6	2.0
	Beef stew	4	0	1	0	0	5	1.7
	Beans	1	2	0	2	0	5	1.7

TABLE XIX

GENERAL TROOP ACCEPTANCE - SUMMARY OF RESPONSES PERTAINING TO OVERALL
SUITABILITY OF THE MEALS FOR USE BY THE SOLDIER

Responses (Rating scale)	Test sites using both Meal, Ready-to-Eat (MRE) & Meal, Combat, Individual (MCI)										TOTAL		Meal, Ready-to- Eat only Fort Bragg (Sp Forces)
	Ft Polk (Inf)		Ft Polk (Ord)		Camp Pickett (Sup & Svc Bn)		Camp AP Hill (Eng)						
	MRE	MCI	MRE	MCI	MRE	MCI	MRE	MCI	MRE	MCI			
Very suitable (7)	111	330	3	28	9	24	55	96	178	478	86		
Moderately suitable (6)	190	357	5	29	15	34	76	126	286	546	69		
Slightly suitable (5)	183	88	13	11	19	13	75	63	290	175	29		
Neither suitable nor unsuitable (4)	68	26	9	1	11	4	36	22	124	53	10		
Slightly unsuitable (3)	103	10	15	2	9	0	39	11	166	23	7		
Moderately unsuitable (2)	58	2	10	0	4	1	15	7	87	10	0		
Very unsuitable (1)	97	5	17	1	9	0	40	10	163	16	3		
No. rating	810	818	72	72	76	76	336	335	1294	1301	204		
Avg. rating	4.48	6.16	3.25	6.06	4.42	5.99	4.60	5.64	4.44	6.01	6.00		

minimum of one-third of a bar, as shown in the directions on the wrapper of the trioxane fuel bar, is insufficient for heating the experimental meal, even under ideal conditions. In heating the wet-pack meat components of the experimental meal, for example beefsteak, it was necessary to remove the component from the fiberboard folder overwrap and place it, in its flexible pouch, into the water in the canteen cup. As a result, the soldier most frequently used the same water in the preparation of coffee or cocoa that was used in heating the meat components, as he did not have the time, water, or fuel bars to heat additional water for beverages. Although this method was contrary to the printed instructions provided, it was found to be the most satisfactory and practical method for heating the meals.

Table XVIII shows that while a large proportion of the test participants found the food packages to be "slightly difficult" to open, only 10 percent experienced any major difficulty. The major factor contributing to the difficulty in opening the packages was the need to immerse the food pouches of the wet-pack components into the water of the canteen cup for heating the components. This procedure resulted in the pouches being wet, slippery, and difficult to handle. Further, it appeared that the heat had a toughening effect on the packaging material making it more difficult to tear. The opening of the peanut butter and cheese spread was found to be difficult when the package labels were placed on the tear line of the respective packages. Insuring that the label on each package is below the tear line; i. e., an imaginary line between the tear notches on each side of the package, would greatly increase the ease of opening these items. The packaged bread and cakes would also be considerably easier to open if the fiberboard box overwrap was redesigned to open from the top rather than from the ends. At the present time, it is difficult to remove the baked item from the overwrap since the flexible pouch containing the product is glued to the inside of the box and, in most instances, the overwrap must be torn completely apart to remove the item for consumption. Test participants also listed the vacuum packaged components as being difficult to open.

Approximately 72 percent of the respondents stated that they did not have any difficulty in eating the foods directly from the package. The major comments pertained to the spoon being too short or the package too deep. The dehydrated fruits were difficult to eat from the package due to the overwrap of the item within the flexible pouch which was difficult to remove and interfered in removing the product from the pouch while eating. The configuration of some of the meat components and

whether or not they were packaged in a sauce had a bearing on the ease or difficulty in eating from the packages. For example, beef slices with barbecue sauce was found to be one of the most difficult items to eat directly from the package. Observations made during the field use phases showed that after several days experience with the experimental meal the test participants found it easier to eat from the packages. A related problem pertaining to eating components of the experimental meal from the flexible packages was the difficulty of handling some food items after preparation because the opened package could not be placed on the ground as is possible with the rigid metal cans of the standard meal.

Table XIX shows a substantial difference between the average overall suitability rating for the experimental and standard meals for each test unit with the standard meal being rated as the most suitable for use in all instances. Statistical analysis of the difference in the rating between the experimental and standard meals by test unit and combined across test units showed the difference in suitability to be significant at the 5-percent probability level in all instances. The overall suitability rating for the Meal, Ready-to-Eat, by Special Forces was considerably higher than like ratings obtained in Infantry and support type units. The favorable attitude of Special Forces personnel toward the flexibly packaged foods exhibited in this and previous tests is attributed to the excellent portability characteristics of these items. The portability characteristics of the flexibly packaged food items of the Meal, Ready-to-Eat, allow the soldier to carry a maximum number of meals at one time with greater ease than is possible with the metal cans of the Meal, Combat, Individual. Further, the flexible packages are easier to dispose of and are otherwise more suitable from a security standpoint than the metal cans of the standard meal. These features are of major importance to Special Forces personnel in the accomplishment of their mission. While the experimental meal was found to be suitable for use by Special Forces, the level of the ratings for the Infantry and support type units generally was midway between the slightly suitable and the neutral categories on the rating scale and therefore is considered marginally suitable for use by these units.

The standard meal was considered more suitable for use than the experimental meal from both a command and user standpoint. Only in the area of mobility which includes carrying meals was the experimental meal considered more suitable than the standard meal. The experimental ration was considered only marginally suitable for use in most instances, and while it could be used as now packaged, test data indicate

that overall improvements are required to insure that it will be equal to the present standard ration. The performance of the trioxane fuel bars was satisfactory; however, fewer problems were encountered in heating the standard ration. The use of the canteen cup as a heating vessel for water in the preparation of foods did not present any major problems. Although not an expendable item from a supply standpoint, the canteen cup is an item normally carried by the soldier and the use of the cup in the preparation of foods, as appropriate, eliminates the need for a special item of equipment for this purpose. No problems were observed in opening the meal cases; however, minor difficulties were encountered in opening individual packages by test participants and indicate improvements are necessary. Many favorable comments were made with regard to the inclusion of rifle cleaning patches in the experimental meal.

2. 11 CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL PROTECTION

2. 11. 1 Objective

To determine whether the cases and packages of the experimental Meal, Ready-to-Eat, are as resistant to CBR and atomic effects as the standard Meal, Combat, Individual.

2. 11. 2 Method

The responsibility for the evaluation of the resistance of cases and packages to chemical and biological agents was assigned to Dugway Proving Grounds (App. IV, Ref. 9). Forty cases each of the experimental and standard meals were provided by USAGETA for this evaluation. Procedures for the conduct of this phase of the test were established by the Project Officer, Dugway Proving Ground, and included the exposure of both types of meals in their shipping cases to chemical and biological agents. After exposure, cases and packages were examined for resistance to these agents. Supplemental data pertaining to the objective of this subtest were provided by the U. S. Army Natick Laboratories:

2. 11. 3 Results

While necessary testing in connection with the chemical and biological evaluation has been completed, test results were not available in sufficient time to be shown in this report. Pertinent results and analysis in this connection will be published at a later date. Based on available research data provided by the U. S. Army Natick Laboratories, the cases and packages of the Meal, Ready-to-Eat, Individual,

will provide adequate protection to food components with regard to radiological and atomic effects if package integrity is maintained. However, research and testing in this respect is continuing.

2.11.4 Analysis

The extent to which the experimental Meal, Ready-to-Eat, met the Military Characteristics with regard to chemical and biological protection will be published at a later date. On the basis of available data, the experimental meal meets the requirements of the Military Characteristics with respect to radiological and atomic effects.

2.12 STORAGE AND TRANSIT EVALUATION

2.12.1 Objective

To determine the capability of the Meal, Ready-to-Eat, Individual, to withstand environmental conditions encountered in storage and transit as prescribed in the Military and Technical Characteristics and AR 705-15 as amended.

2.12.2 Method

a. Storage Stability

The experimental meals, in the shipping cases, were placed in a climatic chamber at USAGETA or otherwise subjected to each storage and environmental condition as follows:

(1) A 6-month storage at 100°F.

(2) Repeated freezing and thawing with ambient temperatures of -50°F. and 114°F. alternated on a 12-hour cycle for a total of 40 freezing and thawing cycles. Product temperature ranged from a low of -19°F. to a high of 97°F.

(3) A 3-month storage (22 November 1966 to 3 March 1967) in a hot-wet environment in Panama in connection with the shipping and handling subtest (Par. 2.8). Weather summary for this period is shown in Appendix I-Q. Storage conditions included outside storage of individual cases stacked on pallets and covered with a tarpaulin, outside storage of

palletized unit loads and covered with a tarpaulin, outside storage of individual cases without any covering, and inside storage of individual cases (Figs. 8 and 9).

Upon completion of the 6-month storage at 100°F., cases and components of the Meal, Ready-to-Eat, were examined for any visible evidence of damages, adverse changes, or failures of components or packaging. Samples of the experimental meal from this storage condition were used in soldier-consumer panel preference tests and compared with like control items, which had been stored at 35°F. to evaluate the storage stability of the food components with regard to acceptability. These panel preference tests (Figs. 10 through 13) were conducted at Fort Lee using the facilities of USAGETA. All food components were evaluated during 20 test sessions in which 36 different enlisted men were used for each test session. The food components were grouped into pairs for serving at each test session with consideration for the compatibility of items within a pair insofar as possible. All foods were prepared, i. e., heated, rehydrated, or otherwise prepared as appropriate, and served on coded plates to the test subjects. Two pairs of foods one at a time, which included a sample from each of the storage conditions, were served at each test session. The samples were served so as to randomize any serving order preferences and other variables. Each test subject tasted each of the samples within the pair and completed a questionnaire in which he stated a preference, by code number, for either the sample stored at 100°F. or 35°F. Further, he indicated on the questionnaire the intensity of his preference for one sample over the other.

With regard to the repeated freezing and thawing evaluation, withdrawals were made after 1/2, 1, 2, 3, 4, 7, 10, 15, 25, and 40 days of storage and cases and components were inspected after each withdrawal for any visible evidence of damages, adverse changes, or failure of components and packaging resulting from the storage conditions as cited above. At the end of the Panama storage phase, test team personnel of USAGETA, assisted by personnel of USATTC, made a visual inspection of each case under each storage condition and removed all cases with any evidence of damage for a detailed inspection. In addition, 200 cases were selected randomly for a 100-percent inspection of cases and components for any visible evidence of damages, adverse changes, or failure of components and packaging resulting from transportation, handling, and storage.

b. Safe Storage and Transit

The experimental meal was placed in a climatic or vacuum chamber at USAGETA and subjected to the environmental conditions as follows:

- (1) 3-day storage at -80°F .
- (2) 3-day storage at 125°F .
- (3) 2-day storage at 105°F .
- (4) 2-day storage at -25°F .
- (5) Air pressure equivalent to that at 40,000 feet altitude (5.00 inches of mercury or 2.47 PSI) for 1 hour as specified in AR 705-15 as amended.
- (6) Air pressure equivalent to that at 50,000 feet altitude (3.42 inches of mercury or 1.69 PSI) for 1 hour as specified in Military Specification MIL-E-4970-A and Mil Standard 810-A (USAF).

Upon completion of the storage periods, cases and components were inspected for any visible evidence of damages, adverse changes, or failures of components. With regard to the exposure to low pressure, the experimental meal was subjected to each of the above conditions as complete cases in the original shipping case, as individual meals in the fiber-board carton overwrap, and as individual components. Observations were made of the items through the glass walls of the chamber during the exposure period and records were made of any observed presence or absence of distention in the cases, meal cartons, and packaging of individual meal components. Upon completion of the exposure periods, all items were inspected for any evidence of failure of cases, meal cartons, and packaging of individual components.

2.12.3 Results

a. Storage Stability

Observed changes noted by USAGETA personnel in food components of the experimental meal after 6 months of storage at 100°F .

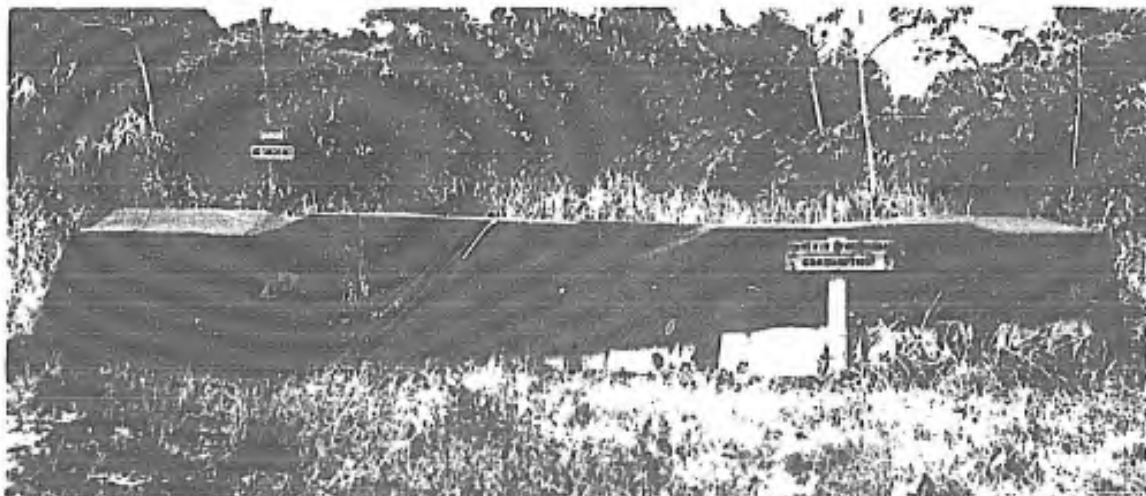
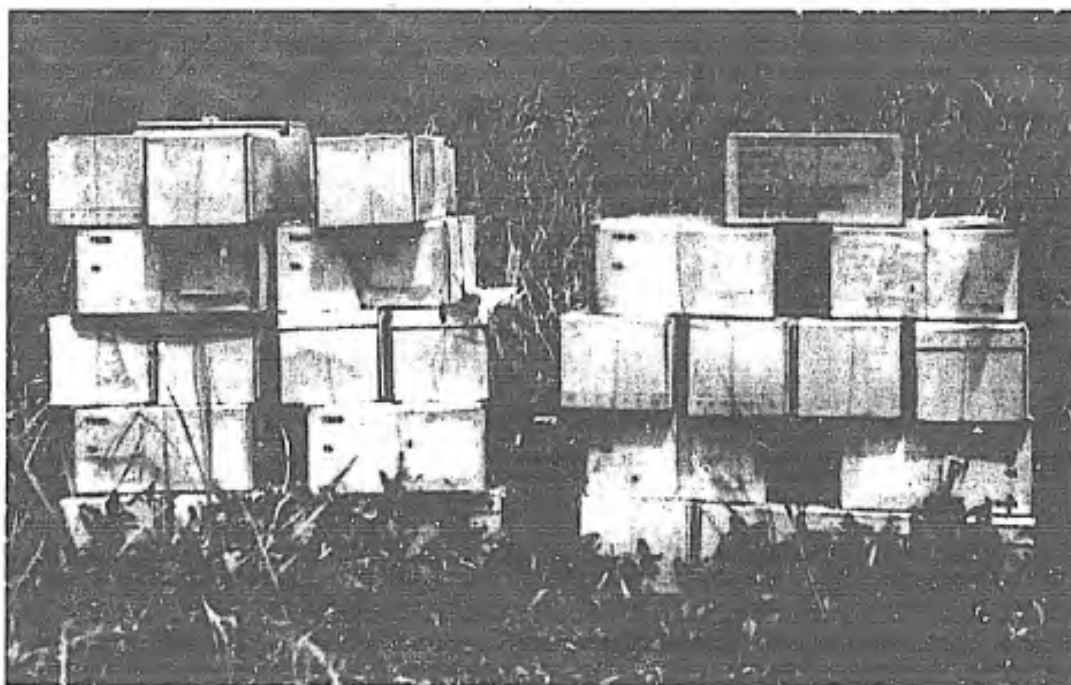


Figure 8. Outside storage with tarpaulin (in Panama).



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Figure 9. Outside storage without tarpaulin (in Panama).

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NEGATIVE 1P(c) 22P



Figure 10. Orientation during a panel test session.



Figure 11. Placing prepared food samples on coded plates for a panel test session.

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TECOM 8-3-7400-06/07/08

NEGATIVE 58, 55



Figure 12. Serving food samples to test participants.

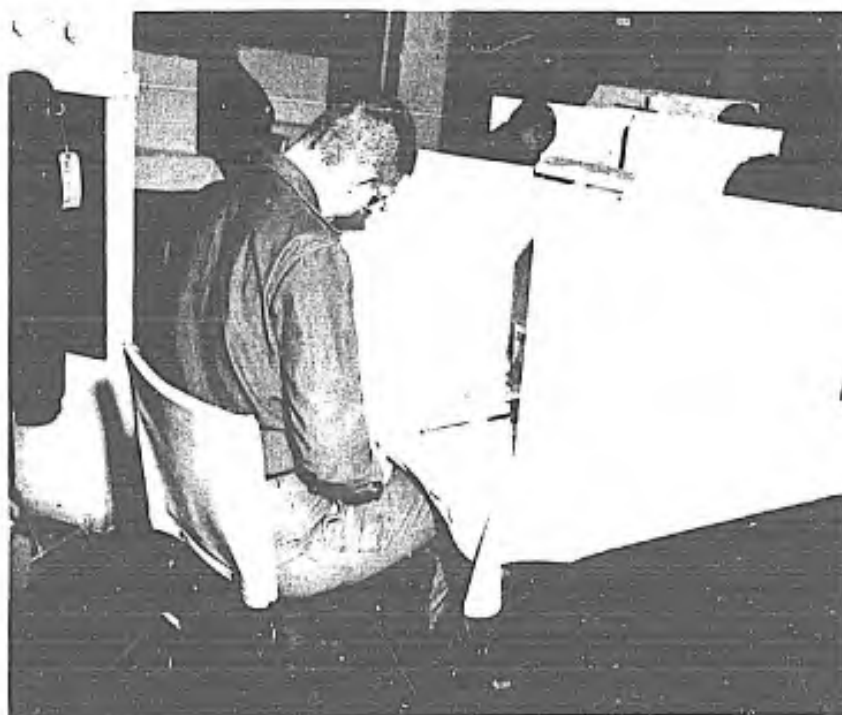


Figure 13. Test participants completing preference data sheet.

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NEGATIVE 56, 57

when compared with like items stored at 35° F. are summarized in Table XX. The results of the soldier-consumer panel preference tests are shown in Table XXI.

Inspection of the experimental meal after exposure to repeated freezing and thawing showed no visible evidence of damage to the packaging materials, package failure, or substantial change in the appearance, texture, odor, or taste of the individual components for periods up to and including 10 days (10 each freezing and thawing cycles). Inspection of the experimental meal withdrawn after 15, 25, and 40 days showed visible evidence of softness and a general breakdown in the texture of pork sausage links, frankfurters, beefsteak, and chicken loaf. Since it is highly improbable that the experimental meal in normal use situations would be subjected to the above extremes in temperature for more than the equivalent of 10 days, the meal in the ration case is considered as being capable of withstanding normal repeated and thawing temperatures.

A summary of the evaluation of the Meal, Ready-to-Eat, after a 3-month storage period in Panama is shown in Appendix I-R. The 100-percent inspection of the 200 cases selected from the four storage conditions showed essentially the same type and percent of damages and failures as found and reported in connection with the shipping and handling phases (Par. 2.8). Further, since there was no substantial difference in the number and type of damages and failures between the various storage conditions, it is obvious that any damages and failures of components or packaging were due to factors other than storage. Adverse changes to the components of the experimental meal after a 3-month storage period, observed by test team personnel, are shown in Appendix I-S.

b. Safe Storage and Transit Conditions

(1) Low Temperature Storage

Inspection of the packaging and components of the experimental meal after exposure to -25° and -80° F. and allowed to thaw at room temperature showed no evidence of damage to the packaging materials, package failure, or substantial change in the appearance, texture, odor, or taste of the individual food components.

(2) High Temperature Storage

Inspection of the experimental meal after exposure to 105° F. and allowed to cool to room temperature showed no evidence of

TABLE XX

OBSERVED CHANGES IN COMPONENTS OF THE MEAL,
READY-TO-EAT STORED FOR 6 MONTHS AT 100°F.

(Storage Stability Evaluation)

COMPONENT	CHANGE
Cereal Bars	Considerably darker in color
Pork Sausage Link	Slightly darker in color
Beans w Tomato Sauce	Slightly darker in color and harder
Pork Pattie (dehy)	Slightly flat taste and odor
Pineapple	Considerably darker in color - sour, fermented taste
Frankfurters	Slight discoloration (greenish spots)
Chicken Loaf	Considerably darker in color
Orange Nut Roll	Slight stale taste
Beefsteak	Slightly drier
Chocolate Covered Cookies	Evidence that chocolate covering had melted; however cookies were useable.
Chicken ala King	Grainy or course appearance and slightly darker in color
Pound Cake	Considerably darker in color - texture dry and crumbly
Beef Loaf	Slightly darker in color
Peaches (dehy)	Solidified into a hard mass. Required approx. 90 minutes for rehydration
Ham & Chicken Loaf	Slightly darker in color
Pears (dehy)	Darker in color and solidified into a hard mass. Required approximately 120 minutes for rehydration.
RaisinNut Roll	Considerably darker in color-texture dry and crumbly
Beef Slices w/BBQ Sauce	Slight loss of spicy flavor and aroma
Strawberries (dehy)	Solidified into a hard mass. Required approx. 75 minutes for rehydration
Fruit cake	Slightly darker in color - Texture dry and crumbly
Cheese Spread	Slightly darker in color - sharper taste
Apricots (dehy)	Solidified into a hard mass. Required approx. 120 minutes for rehydration.
Date Pudding	Slightly darker in color
Jelly	Slightly darker in color
Bread	Considerably darker in color
Catsup Mix, Dry	Hard and difficult to rehydrate
Soup and Gravy Base, Beef	Hard and difficult to rehydrate
Cream Substitute, Dry	Delamination of packaging materials resulting in the separation of the dull outer covering and leaving the package shiny and a reflector of light.

TABLE XXI

**SUMMARY OF SOLDIER-CONSUMER PANEL PREFERENCE TESTS OF THE MEAL,
READY-TO-EAT COMPONENTS STORED AT 100°F. AND 35°F. FOR 6 MONTHS**

(Storage Stability Evaluation)

Food Item	No. Subjects Preferring Item Stored At		Chi Square Value *	Probability Level**
	100°F.	35°F.		
Pineapple	4	32	21.90	Δ .001
Date Pudding	6	30	20.03	Δ .001
Beef Slices W/BBQ Sauce	5	31	18.36	Δ .001
Chicken ala King	6	30	18.01	Δ .001
Strawberries	7	29	12.74	Δ .001
Vanilla Cream Bar	11	25	11.45	Δ .001
Chocolate Covered Brownies	9	27	10.20	Δ .005
Beef Stew	11	25	9.97	Δ .005
Beans W/Tomato Sauce	9	27	9.88	Δ .005
Beef Loaf	9	27	8.46	Δ .005
Gr. Beef W/Pickle Sauce	10	26	8.34	Δ .005
Orange Cereal Bar	10	26	8.19	Δ .005
Raisin Nut Roll	10	26	7.34	Δ .01
Pork Pattie	14	22	6.89	Δ .01
Chocolate Bars W/Almonds	9	27	6.50	Δ .05
Apricots	11	25	5.32	Δ .05
Pears	12	24	4.00	Δ .05
Chocolate Fudge Bar	13	23	3.79	▽ .05
Cocoa	12	24	3.62	▽ .05
Pork Sausage Link	23	13	3.48	▽ .05
Jelly	23	13	3.03	▽ .05
Peanut Butter	23	13	2.64	▽ .05
Chicken Loaf	15	21	1.85	▽ .05
Chocolate Nut Roll	15	21	1.84	▽ .05
Chocolate Covered Cookies	21	15	1.71	▽ .05
Crackers	14	22	1.53	▽ .05
Apricot Cereal Bar	14	22	1.32	▽ .05
Coffee	21	15	1.21	▽ .05
Beef Steak	15	21	.90	▽ .05
Peaches	17	19	.86	▽ .05
Fruit Cake	14	22	.69	▽ .05
Bacon	16	20	.66	▽ .05
Frankfurters	16	20	.44	▽ .05
Beef Pattie	16	20	.28	▽ .05
Bread	19	17	.25	▽ .05
Orange Nut Roll	15	21	.18	▽ .05
Potato Pattie	19	17	.11	▽ .05
Pound Cake	15	21	.08	▽ .05
Cheese Spread	18	18	.06	▽ .05
Ham & Chicken Loaf	18	18	.00	▽ .05

* The method of analysis takes into consideration preference ratings.

** Δ The difference in preference is significant at the indicated probability level.

> The difference in preference is not significant at the indicated probability level.

damage to the packaging materials, package failure, or substantial change in the appearance, texture, odor, or taste of the individual components except for the chocolate covered cookies and all dehydrated fruits. There was evidence of melting of the chocolate covering of the cookies; however, at room temperature the chocolate covering was intact and the cookies were suitable for use. The rehydration time for the dehydrated fruits was found to be considerably longer which indicated a change in the qualities of these items. With regard to the storage of the experimental meal at 125°F., inspection of a portion of the total number of cases immediately upon removal from the climatic chamber showed changes as follows:

- (a) Melted chocolate covering of cookies and brownies.
- (b) Softened cereal bars.
- (c) Moisture accumulation within the packaging and on the surface of all baked items.
- (d) Melted chocolate covering of candy bars within the accessory packet to such an extent that the oils in the covering seeped through the seals of the candy bar wrappers onto the other components in the packet.
- (e) Rehydration qualities of the dehydrated fruits were adversely affected.

Inspection of the remaining cases stored at 125°F. which were allowed to return to room temperature showed that the chocolate covering of the cookies and brownies had hardened and the items were usable although there was some adherence of the chocolate covering to the packaging material. The cereal bars and baked items appeared to be normal; the chocolate covering of candy bars had hardened and the items were useable although other accessory packet items were oily or greasy, and the problem in the rehydration of dehydrated fruits was still present.

(3) Low Pressure

Observations and inspection of the experimental meal exposed as unopened cases, individual meals, and individual components to air pressures as cited above showed no damages or failures of any practical importance.

2.12.4 Analysis

a. Storage Stability

Examination of Table XX shows that there were adverse changes in the majority of the components due to storage. That these changes had an adverse effect on the acceptability of the items was reflected during the soldier-consumer panel preference tests as the majority of the food components for which adverse changes were noted were also the items with low preference. Results of the panel tests (Table XXI) shows that the statistical analysis of the difference in preference was significant for 17 (42.5 percent) of the 40 individual food components tested. Further, it is noted that 7 of the 17 food components referred to above are the major food item in 7 menus. The above indicates a significant loss in palatability of the specified items due to storage at 100°F. for 6 months, and is considered a shortcoming. In addition to a significant loss in palatability of three of the four dehydrated fruits (strawberries, apricots, and pears), the changes in the rehydration qualities of all dehydrated fruits which necessitated a substantial increase in preparation time will have a bearing on the utility of the meal since any rehydration time in excess of 10 minutes would be considered unrealistic from both a command and user standpoint. This is considered a shortcoming. Further, the physical state (hardness) of these items would have an adverse effect on the acceptability if the items were eaten dry, i. e., without rehydration.

While the evaluation of the Meal, Ready-to-Eat, stored for 3 months in Panama was limited to visual examination and inspection, the performance of the experimental meal in its ration case was extremely good from a storage stability standpoint under the storage conditions. However, it appeared that if the storage period had been extended there may have been considerable damage to the meals as the termites had built tunnels on the outside of several cases and it would have been only a matter of time before heavy infestation on the inside of these and other cases would have taken place. This would have affected the edibility of the food components.

Data provided by Natick Laboratories indicated that, while nutritional analyses of components of this meal stored for 6 months at 100°F. are not yet available, previous studies have shown nutrient retention of the wet-pack components to be similar to that of canned foods, and where package integrity is maintained, it is anticipated that nutrient

retention will be equivalent to that of the canned counterpart item in the Meal, Combat, Individual. Data obtained also indicate that previous storage studies of dehydrated foods have shown good stability of Riboflavin, Thiamine, and Niacin and, in addition, carriers of known stability have been used to assure retention of vitamins A and C. The capability of the meal to withstand long-term storage (2 years or longer) without refrigeration was not determined nor was data available in this connection.

The requirements of the Military and Technical Characteristics with regard to storage stability of the Meal, Ready-to-Eat, were only partially met. Improvements in the storage stability of the food components are indicated to include the storage problem in connection with dehydrated fruits. Specific shortcomings relating to palatability and rehydration characteristics of fruits are stated above.

b. Safe Storage and Transit

Since no problems were observed in the exposure of the food components to extreme low temperature storage conditions, the experimental meal is considered capable of withstanding low temperature encountered in storage and transit as stipulated in AR 705-15 as amended. On the contrary, some adverse effects were observed when the food components were exposed to extreme high temperature storage conditions of 105° and 125°F. for 2 and 3 days, respectively. Although the chocolate covered cookies, brownies, and candy bars subjected to these temperatures were considered as suitable for use, a certain amount of the covering is lost because it adheres to the package wrapper. Further, eating these items by the soldier in the field at temperatures above 100°F. would be quite messy. The major adverse effect found as a result of the high temperature exposures was the change in the rehydration qualities of the dehydrated fruits as discussed above. It is noted that during this test a high temperature of 125°F. was used for storage rather than the 155°F. as stipulated in paragraph 7.1a, AR 705-15, as amended. A high temperature of 125°F. was used since it appeared to be more realistic and comparable to high temperatures which may be encountered in normal use.

The performance of the packaging and components of the Meal, Ready-to-Eat, with regard to air transit conditions was excellent. Not only did the packaging and components satisfactorily withstand air pressure equivalent to 40,000 feet altitude as stipulated in AR 705-15, as

amended, but also satisfactorily withstood air pressure equivalent to 50,000 feet altitude.

The Meal, Ready-to-Eat, partially meets the requirements of the Military Characteristics pertaining to safe storage and transit conditions. The major problem observed in this area is the adverse effects of high temperatures on the dehydrated fruits.

2.13 HUMAN FACTORS EVALUATION

2.13.1 Objective

To determine if the Meal, Ready-to-Eat, Individual, has been designed in conformance with human use factors.

2.13.2 Method

In addition to pertinent evaluations as outlined in other subtests, general observations were made by test team personnel with regard to features or characteristics of the Meal, Ready-to-Eat, Individual, which appeared to be incompatible with human use factors.

2.13.3 Results

As shown in paragraph 2.10, some difficulties were encountered in opening individual meal component packages by the soldier. Therefore, improvements in the design of the packages to facilitate opening components would improve the man-material compatibility of the Meal, Ready-to-Eat. During the field use phases, the soldier experienced minor problems in handling some of the experimental meal items after preparation because the opened flexibly packaged food items could not be placed in an upright position on the ground as was possible with the rigid metal cans of the standard meal. For example, more often the soldier would add the required amount of water to dehydrated fruits and set the opened package on the ground or against a tree while eating the meat component. Frequently, when using this procedure the flexible package would fold or bend or otherwise fall over resulting in some spillage of the contents.

2.13.4 Analysis

Except for the above, the features and characteristics of the Meal, Ready-to-Eat, are satisfactory from a human factors standpoint.

2. 14 VALUE ANALYSIS

2. 14. 1 Objective

To determine whether there are features in the design, materials, or general configuration of the Meal, Ready-to-Eat, which are not essential to its proper performance.

2. 14. 2 Method

During the conduct of other subtests, observations were made by test team personnel to determine if the experimental meal incorporated any features which could be eliminated without compromising its acceptability, utility, and general performance.

2. 14. 3 Results

The general design of the Meal, Ready-to-Eat, was found to be satisfactory. Materials used in the shipping cases, meal cartons, and individual components packaging were of good quality and sufficiently durable to provide adequate protection to components in most instances.

2. 14. 4 Analysis

Design features, materials, and general configuration currently used in the Meal, Ready-to-Eat, are considered essential to its performance.

2. 15 SAFETY

2. 15. 1 Objective

To determine that the Meal, Ready-to-Eat, does not present any safety hazard to the user.

2. 15. 2 Method

Meals required for troop consumption during the field use phase (Par. 2. 7) were carefully inspected prior to issue. The inspection (Par. 2. 2) involved the visual examination of each meal (Figs. 14 and 15) to determine that it did not contain foodstuffs nor was it packaged in a manner which would subject the user to any safety hazards. The developer (U. S.



Figure 14. Safety inspection of components.



Figure 15. Repackaging components and inserting food rating card.

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FORT LEE, VA.

TECOM 8-3-7400-06/07/08

NEGATIVE 18, 21

Army Natick Laboratories) conducted this inspection with assistance of test team personnel of USAGETA and USAIB. Further observations were made during the field use phases for any potential safety hazards in the use of the experimental meal by the user.

2. 15. 3 Results

Observations made during the field use phases showed no evidence of safety hazards to the user from a handling standpoint. However, results of the inspection of meals (Par. 2. 2) for consumption during the field use phases showed damages and failures which apparently resulted during the processing and assembling of the food components. Although the percent of damages and failures was relatively low, the presence of spoiled foods in meals or the improper packaging of components with the resultant risk of contamination and food spoilage during subsequent handling, shipping, and storage is a potential safety hazard to the user. This is considered a deficiency.

2. 15. 4 Analysis

The need for improvements in packaging techniques and quality control procedures are required to insure that all food items issued to troops are safe for consumption and to eliminate the necessity for a 100 percent inspection of items from a safety standpoint immediately prior to consumption.

SECTION 3. APPENDICES

APPENDIX I - TEST DATA

- A Menus and Components of Meal, Ready-to-Eat
- B Clothing and Equipment of Test Personnel -
Portability Phase
- C Average Hedonic Rating for Meal, Combat, Individual Menus when Consumed Hot
- D Average Hedonic Rating for Meal, Combat, Individual when Consumed Cold
- E Responses to Adequacy of Meal, Ready-to-Eat Menus
- F Average Percent Consumed of Major Components of Both Rations
- G Summary of Comments Pertaining to Meal, Ready-to-Eat, Individual
- H Summary of Comments Pertaining to Meal, Combat, Individual
- I Weather Data
- J Summary of Damages and Failures to Components
- K Criteria for Judging Package Performance
- L Evaluation of Unit Load (Panama Shipment)
- M Summary of Results of Airdrop by Parachute (High Velocity)
- N Summary of Results of Airdrop without Parachute (Individual Cases with Honeycomb)
- O Summary of Results of Airdrop without Parachute (Cases Lashed Together and without Honeycomb)
- P Summary of Results of Airdrop without Parachute (Cases Lashed Together and with Honeycomb)
- Q Weather Data - Panama C. Z.
- R Evaluation of Meal, Ready-to-Eat After Storage in Panama
- S Observed Changes in Components of the Meal, Ready-to-Eat After Storage in Panama.

APPENDIX II - FINDINGS

APPENDIX III - DEFICIENCIES AND SHORTCOMINGS

APPENDIX IV - REFERENCES

APPENDIX V - DISTRIBUTION LIST

APPENDIX I. TEST DATA

APPENDIX I-A

MENUS AND COMPONENTS OF MEAL, READY-TO-EAT, INDIVIDUAL

Menu 1

Pork Pattie (dehy)
Pineapple
Bread Roll
Jelly
Apricot Cereal Bar

Menu 4a

Beef Loaf
Beans with Tomato Sauce
Bread Roll
Peanut Butter
Raisin Nut Cake

Menu 9

Frankfurters
Bread Roll
Jelly
Chocolate Covered
Brownies

Menu 1a

Chicken Loaf
Peaches (dehy)
Bread Roll
Jelly
Apricot Cereal Bar

Menu 5

Beef Slices w/Barbecue Sauce
Potato Pattie (dehy)
Bread Roll
Peanut Butter
Strawberries (dehy)

Menu 10

Pork Sausage Links
Bread Roll
Cheese Spread
Apricots (dehy)
Orange Cereal Bar

Menu 2

Beans with Tomato Sauce
Bacon
Bread Roll
Pears (dehy)
Cheese Spread
Chocolate covered cookies

Menu 6

Chicken ala King
Crackers
Cheese Spread
Date Pudding

Menu 11

Beef Steak
Bread Roll
Jelly
Fruitcake

Menu 3

Ham and Chicken Loaf
Peaches (dehy)
Bread Roll
Peanut Butter
Chocolate Nut Roll

Menu 7

Gr. Beef in pickle
flavored sauce
Potato Pattie (dehy)
Bread Roll
Cheese Spread
Chocolate Covered Cookies

Menu 12

Chicken Loaf
Potato Pattie (dehy)
Bread Roll
Orange Nut Roll
Cocoa Beverage Powder
Jelly

Menu 4

Beef Pattie (dehy)
Beans with Tomato Sauce
Peaches (dehy)
Bread Roll
Cheese Spread
Cocoa Beverage Powder

Menu 8

Beef Stew
Crackers
Peanut Butter
Pound Cake
Orange Cereal Bar

NOTE:

Each menu contains an accessory packet, a plastic spoon, and a paper cleansing towel.

APPENDIX I-B

CLOTHING AND EQUIPMENT WORN OR CARRIED BY PERSONNEL OF ADVANCED INFANTRY TRAINING COMPANIES

Items worn or carried on person:

- Trousers and jacket, utility
- Field jacket (as required)
- Wool or cotton underwear (as required)
- Steel helmet w/liner
- Boots, combat
- Socks, wool
- Overshoes (as required)
- Pistol belt
- Suspenders, field pack, combat
- Pack, field, canvas, combat, M-55
- Entrenching tool w/carrier
- Pouch, ammunition, small arm (2 ea)
- Canteen, canteen cup and cover (2 ea)
- First aid packet
- Individual weapon (Rifle M-14 or Pistol 45 cal.)
- Bayonet w/scabbard

Items carried in pack:

- Underwear - 1 set
- Socks, wool - 1 pair
- Poncho
- Toilet articles
- Towel

APPENDIX I-C

AVERAGE HEDONIC RATING FOR MEAL, COMBAT, INDIVIDUAL MENUS WHEN CONSUMED HOT
(Major Components Heated)

Menu * Codes	Fort Polk (Inf)			Fort Polk (Ord)			Camp Pickett (Sup & Svc Bn)			Camp AP Hill (Reg)			All Test Sites and Units Combined		
	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	
A	105	7.25	83	7.01	13	7.31	120	7.16	321	7.16	321	7.16			
B	93	7.31	95	7.12	17	7.59	118	7.08	323	7.18	323	7.18			
C	103	7.27	86	7.06	19	7.58	110	7.08	318	7.17	318	7.17			
D	95	7.66	87	6.90	24	7.50	108	7.09	314	7.24	314	7.24			
E	100	7.53	81	6.92	24	7.83	108	7.23	313	7.29	313	7.29			
F	88	7.34	75	7.03	21	7.66	115	7.17	299	7.22	299	7.22			
G	87	7.42	72	7.44	19	7.63	111	7.38	289	7.42	289	7.42			
H	98	6.99	85	6.52	19	7.89	111	6.78	313	6.84	313	6.84			
I	87	7.32	81	6.83	16	7.38	124	7.06	308	7.09	308	7.09			
J	94	7.07	80	6.46	17	7.53	120	6.92	311	6.88	311	6.88			
K	99	6.66	69	6.26	21	6.81	108	7.05	297	6.72	297	6.72			
L	110	7.26	97	7.31	22	7.50	120	6.97	349	7.19	349	7.19			

* Menu Identification Code:

- | | | |
|------------------------------------|--------------------------|--------------------------|
| A - Meat Balls W/Beans | E - Chicken and Noodles | I - Turkey Loaf |
| B - Beef Slices & Potatoes W/Gravy | F - Ham, Fried | J - Pork Slices |
| C - Chicken, Boned | G - Beans W/Frankfurters | K - Ham and Eggs |
| D - Beefsteak | H - Ham and Lima Beans | L - Beef, Spiced W/Sauce |

APPENDIX I-D

AVERAGE HEDONIC RATINGS FOR MEAL, COMBAT, INDIVIDUAL MENUS WHEN CONSUMED COLD

(All Components Unneated)

Menu Codes	Fort Polk (Inf)		Fort Polk (Ord)		Camp Pickett (Sup & Svc Bn)		Camp AP Hill (Eng)		All Test Sites and Units Combined	
	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating	No. Ratings	Avg. Rating
A	160	7.21	10	7.40	5	7.80	21	6.52	196	7.16
B	164	7.21	8	6.25	6	7.17	7	6.28	185	7.13
C	178	7.31	12	7.42	3	7.33	16	7.25	209	7.31
D	164	7.13	10	6.90	6	6.33	11	6.45	191	7.05
E	162	7.38	14	7.21	6	6.50	13	6.69	195	7.11
F	162	7.24	16	7.69	5	7.40	16	6.19	199	7.20
G	157	7.41	12	7.25	3	7.33	19	7.05	191	7.36
H	167	6.96	7	6.14	4	6.50	22	6.64	200	6.89
I	181	7.45	15	6.60	5	5.40	9	6.78	210	7.31
J	178	7.21	13	6.69	3	7.33	11	6.64	205	7.15
K	158	6.86	16	7.38	11	6.18	19	6.26	204	6.81
L	206	7.40	8	6.75	5	7.20	20	7.00	239	7.34

* Menu Identification Code:

A - Meat Balls W/Beans	E - Chicken and Noodles	I - Turkey Loaf
B - Beef Slices & Potatoes W/Gravy	F - Ham, Fried	J - Pork Slices
C - Chicken, Boned	G - Beans W/Frankfurters	K - Ham and Eggs
D - Beefsteak	H - Ham and Lima Beans	L - Beef, Spiced W/Sauce

APPENDIX I-E

SUMMARY OF RESPONSES AS TO ADEQUACY OF QUANTITY OF FOOD IN MEAL, READY-TO-EAT MENUS

Responses	Menu 1		Menu 1A		Menu 2		Menu 3		Menu 4		Menu 4A		Menu 5		Menu 6		Menu 7		Menu 8		Menu 9		Menu 10		Menu 11		Menu 12		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
More than enough	28	4.8	12	3.8	33	3.9	25	3.1	18	3.4	18	5.7	38	4.6	30	3.5	20	2.4	28	3.4	24	2.8	37	4.4	35	4.2	34	4.1	380	3.8
Enough	314	53.5	173	54.7	504	60.3	447	55.4	290	54.9	178	56.3	491	59.3	430	50.8	500	59.7	460	55.5	488	57.4	446	53.5	483	58.2	478	58.0	5682	56.4
Not enough	232	39.5	121	38.3	281	33.6	308	38.2	206	39.0	111	35.1	285	34.4	366	43.3	300	35.9	326	39.3	319	37.5	328	39.3	292	35.2	294	35.6	3769	37.4
No Answer	13	2.2	10	3.2	18	2.2	27	3.3	14	2.7	9	2.9	14	1.7	20	2.4	17	2.0	15	1.8	19	2.3	23	2.8	20	2.4	19	2.3	238	2.4
Total	587	100	316	100	836	100	807	100	528	100	316	100	828	100	846	100	837	100	829	100	850	100	834	100	830	100	825	100	10969	100

NOTE: No. denotes number of responses
% - denotes percent

APPENDIX I-F

OVERALL PERCENT CONSUMED OF MAJOR FOODS MEAL, READY-TO-EAT AND MEAL, COMBAT, INDIVIDUAL

MEAL, READY-TO-EAT			MEAL, COMBAT, INDIVIDUAL		
Food Item	No. of Observations	Overall Percent Consumed	Food Item	No. of Observations	Overall Percent Consumed
Choc. Covered Cookies	1526	94	Peaches	501	98
Frankfurters	784	94	Chicken & Noodles	503	97
Beef Stew	758	93	Bean W/Frankfurters	473	97
Pork Sausage Links	764	93	Beef Spiced W/Sauce	570	96
Beef Steak	756	92	Meat Balls W/Beans	529	95
Strawberries	747	92	Beef Slices & Potato	519	95
Pineapple	534	92	Boned Chicken	523	95
Gr Beef in Pickle Flavored Sauce	768	92	Beef Steak W/Juices	511	95
Ham & Chicken Loaf	735	91	Fried Ham	478	95
Choc. Candy Bar	1548	91	Turkey Loaf	509	95
Chicken aLa King	770	91	Fruit Cocktail	503	95
Chicken Loaf	1049	90	Pears	505	95
Beans W/Tomato Sauce	1530	90	Cookies	1625	95
Bacon	759	90	Pork Slices	501	94
Crackers	1508	89	Apricots	471	92
Beef Slices W/BBQ	761	89	Ham & Eggs	487	91
Pork Pattie	528	89	Ham & Lima Beans	514	91
Beef Pattie	475	88	Crackers	1013	91
Beef Loaf	290	88	Fruit Cake	513	89
Jelly	1388	88	Jam	1060	89
Choc. Covered Brownies	781	87	Bread	1533	87
Vanilla Candy Bar	751	87	Pecan Roll	462	86
Peaches	1197	87	Vanilla Cream Candy Bar	491	85
Apricots	711	86	Pound Cake	545	83
Cocoa	1184	85	Date Pudding	487	82
Potato Pattie	1498	82	Cocoa	1784	81
Fruit Cake	749	81	Peanut Butter	1986	81
Peanut Butter	927	81	Cheese Spread	1966	76
Pears	125	81	Coffee	2694	72
Pound Cake	733	80			
Raisin Nut. Cake	284	78			
Bread	1033	77			
Date Pudding	756	75			
Orange Nut Roll	735	75			
Coffee	1339	74			
Choc. Nut Roll	732	72			
Cheese Spread	1494	70			
Apricot Cereal Bar	827	69			
Orange Cereal Bar	1475	57			

APPENDIX I-G

SUMMARY OF TEST PARTICIPANTS' COMMENTS PERTAINING TO MEAL, READY-TO-EAT

(Combined Across Test Sites and Test Units)

Comments	No. Comments	Percent
Bread is bad	379	10.1
Very Good	322	8.6
Good	309	8.2
Not as good as C ration	300	8.0
Not good	288	7.7
Not enough to eat	234	6.2
Hard to open	147	3.9
Not enough accessories	136	3.6
Fair	129	3.4
Take too long to heat	127	3.4
Taste not very good	105	2.8
Too dry	94	2.5
Better than C ration	88	2.4
Too much water required	88	2.4
Cereal bar bad	85	2.3
Need more fruit	76	2.0
Not enough variety	67	1.8
Could be improved	62	1.7
Needs something to drink	58	1.5
Would be better heated	45	1.2
Need more time to prepare	41	1.1
Delete chocolate nut roll	40	1.1
Spoon not large enough	36	1.0
Need beverage not requiring heat	34	.9
Too salty	34	.9
Package heat bars with meal	32	.8
Dehydrated fruit not good	30	.8
Bread moldy	30	.8
Need toothpick	29	.8
Not enough meat	29	.8
Pound cake bad	23	.6
Other unfavorable comments	219	5.8
Other favorable comments	33	.9
TOTAL 3,749		100

APPENDIX I-H

SUMMARY OF TEST PARTICIPANTS' COMMENTS PERTAINING TO

MEAL, COMBAT, INDIVIDUAL

(Combined Across Test Sites and Test Units)

Comments	No. Comments	Percent
Very good	374	19.7
Good	352	18.5
Not enough to eat	213	11.2
C ration better than test rations	205	10.8
Fair	101	5.3
Not good	72	3.8
Need beverage not requiring heat	58	3.1
Too salty	55	2.9
Could be improved	39	2.1
Need more fruit	36	1.9
Taste not very good	27	1.4
Bread is bad	24	1.3
Would be better heated	23	1.2
Greasy	22	1.2
Filling	20	1.1
Put opener with each meal	20	1.1
Pack heat bars with meal	20	1.1
Foreign matter in food (Paint from canned fruit)	18	.9
Not enough accessories	18	.9
Suitable for a combat ration	15	.8
Don't like the cans	12	.6
Too dry	12	.6
Need something to drink	12	.6
Too many crackers, more bread	12	.6
Test ration better than C ration	10	.5
Too much fat on meat	10	.5
Hard to open	10	.5
Put candy in each meal	10	.5
Other favorable comments	1	.1
Other unfavorable comments	98	5.2
TOTAL	1,899	100

APPENDIX I-I

SUMMARY OF WEATHER DATA - FORT POLK, LOUISIANA FIELD USE PHASE

Date (1966)	Temperature ^a		Relative Humidity ^b		Avg Wind Velocity(Kts)	Precip. (In.)
	Max	Min	Max	Min		
Oct 9	90	75	85	56	2	None
10	86	66	85	50	5	.40
11	81	57	78	31	3	None
12	69	63	100	61	4	None
13	83	69	97	67	5	.88
14	87	74	97	61	7	.40
15	77	54	86	48	10	2.08
16	73	49	86	46	3	None
17	73	54	90	52	4	None
18	60	49	90	72	5	.95
19	63	47	90	48	7	None
20	67	42	94	43	3	None
21	73	42	90	45	2	None
22	62	57	86	83	2	None

a. Expressed in degrees Fahrenheit.

b. Expressed in percent relative humidity.

SUMMARY OF WEATHER DATA - FORT BRAGG, NORTH CAROLINA (ELLERBE) FIELD USE PHASE

Date (1966)	Temperature ^a		Relative Humidity ^b		Avg Wind Velocity(Kts)	Precip. (In.)
	Max	Min	Max	Min		
Nov 1	74	50	100	57	05	None
2	76	43	100	75	10	1.11
3	49	34	85	37	15	None
4	55	29	92	28	10	None
5	59	32	93	33	08	None
6	68	44	80	38	10	None
7	66	42	90	46	05	None
8	68	40	96	47	05	None
9	73	50	100	60	08	None
10	77	62	93	55	15	.57
11	73	63	94	57	05	None
12	63	55	100	80	08	.32

a. Expressed in degrees Fahrenheit.

b. Expressed in percent relative humidity.

APPENDIX I-I

SUMMARY OF WEATHER DATA - CAMP A.P. HILL, VIRGINIA

FIELD USE PHASE

Date (1966)	Temperature ^a		Relative Humidity ^b		Avg Wind Velocity (Kts)	Precip. (In.)
	Max	Min	Max	Min		
Nov 17	73	44	85	60	Unknown	None
18	77	45	83	65	Unknown	None
19	54	35	73	50	Unknown	None
Dec 12	48	32	90	74	Unknown	None
13	37	18	100	95	Unknown	.87
14	45	32	85	60	Unknown	None
15	45	24	89	63	Unknown	None
16	52	23	91	74	Unknown	None
17	64	32	88	61	Unknown	None

a. Expressed in degrees Fahrenheit.

b. Expressed in percent relative humidity.

c. Not available.

SUMMARY OF WEATHER DATA - CAMP PICKETT, VIRGINIA

FIELD USE PHASE

Date (1966)	Temperature ^a		Relative Humidity ^b		Avg Wind Velocity(Kts)	Precip. (In.)
	Max	Min	Max	Min		
Dec 4	32	17	85	36	5	None
5	43	17	100	48	5	.02
6	55	39	100	37	4	None
7	63	44	100	68	9	Trace

a. Expressed in degrees Fahrenheit.

b. Expressed in percent relative humidity.

APPENDIX I-J

SUMMARY OF DAMAGES AND FAILURES FOUND DURING INSPECTION OF MEAL, READY-TO-EAT COMPONENTS (Shipping and Handling Phases)

FOOD	Motor Freight (20 Cases)			Air Freight (10 Cases)			Rail Freight (20 Cases)			Safety Inspection (1931 Cases)			Panama * (49 Cases)		Panama ** (51 Cases)	
	No. Items Inspected	Defective Seal	Dirty Pkg	No. Items Inspected	Moldy	Pinhole	No. Items Inspected	Moldy	Dirty Pkg.	Defective Seal	No. Items Inspected	Moldy	Dirty Pkg.	No. Items Inspected	Moldy	No. Items Inspected
Bread	200	4	1	100	3	2	200	7	-	1	19,310	173	1	490	20	510
Choc. Covered Brownies	20	-	-	10	-	-	20	-	-	-	1,931	1	-	49	-	51
Choc. Covered Cookies	40	-	-	20	-	-	40	-	-	-	3,862	-	-	98	-	102
Choc. Nut Roll	20	1	-	10	-	-	20	-	-	-	1,931	3	-	49	-	51
Crackers	40	-	-	20	-	-	40	-	-	-	3,862	-	-	98	-	102
Date Pudding	20	-	-	10	-	-	20	-	-	-	1,931	1	-	49	-	51
Fruitcake	20	1	-	10	-	-	20	-	-	-	1,931	-	-	49	-	51
Orange Nut Roll	20	-	-	10	-	-	20	-	-	-	1,931	-	-	49	-	51
Pound Cake	20	-	-	10	-	-	20	-	-	-	1,931	-	-	49	-	51
Raisin Nut Cake	20	-	-	10	-	-	20	-	-	-	1,931	-	-	49	-	51
Cocoa Beverage Powder	40	2	-	20	-	-	40	-	-	-	2,855	-	-	74	-	77
Apricots (dehy)	20	-	-	10	-	-	20	-	-	-	1,931	-	-	49	-	51
Peaches (dehy)	40	-	-	20	-	-	40	-	1	-	3,862	-	-	98	-	102
Pears (dehy)	20	-	-	10	-	-	20	-	-	-	1,931	-	-	49	-	51
Strawberries (dehy)	20	-	-	10	-	-	20	-	-	-	1,931	-	-	49	-	51
Potato Pattie (dehy)	60	-	-	30	-	-	60	-	-	-	5,793	-	-	147	-	153
Pork Pattie (dehy)	10	-	-	5	-	-	10	-	-	-	924	-	-	25	-	26
Beef Pattie (dehy)	10	-	-	5	-	-	10	-	-	-	1,007	-	-	24	-	25
Apricot Cereal Bar	20	-	-	10	-	-	20	-	-	-	1,931	-	-	49	-	51
Orange Cereal Bar	40	-	-	20	-	-	40	-	-	-	3,862	-	-	98	-	102
Subtotal	700	8	1	350	3	2	700	7	1	1	66,578	178	1	1,760	20	1,760

Note: The cases shown above represent the total number of cases inspected rather than the total number of cases in the shipments.

* Inspection upon arrival in Panama - Loose cases.

** Inspection upon arrival in Panama - Palletized unit loads.

APPENDIX I-J

FOOD	Motor Freight (20 Cases)				Air Freight (10 Cases)				Rail Freight (20 Cases)				Safety Inspection (1931 Cases)							Panama* (49 Cases)				Panama ** (51 Cases)			
	No. Items Inspected	Seal Failure	Wall Failure	Sweller	No. Items Inspected	Seal Failure	Wall Failure	Defective Seal	Dirty Pkg.	Sweller	No. Items Inspected	Seal Failure	Wall Failure	Seal Failure	Wall Failure	Sweller	Dirty Pkg.	Delaminated	Pinhole	No. Items Inspected	Seal Failure	Wall Failure	No. Items Inspected	Seal Failure	Wall Failure	Seal Failure	Dirty Pkg.
Bacon	20	-	-	-	10	-	-	-	-	-	1,931	-	1	-	-	-	-	-	-	49	-	-	51	-	-	-	-
Beans W/Tomato Sauce	40	-	-	-	20	-	-	-	-	-	3,862	5	1	-	-	-	1	-	-	98	-	-	102	-	-	-	-
Beef Loaf	10	-	-	-	5	1	-	-	-	-	1,007	1	1	-	-	-	-	-	-	25	-	-	26	-	-	-	-
Beef Slices W/BBQ	20	-	-	-	10	-	-	-	-	-	1,931	8	1	-	-	-	1	-	-	49	-	-	51	-	-	-	-
Beefsteak	20	-	-	-	10	-	-	-	-	-	1,931	1	-	-	-	-	-	-	-	49	-	-	51	-	-	-	-
Beefstew	20	-	-	-	10	-	-	-	-	-	1,931	11	3	3	-	-	-	-	-	49	-	-	51	-	-	-	-
Chicken ala King	20	-	-	-	10	-	-	-	-	-	1,931	2	2	2	-	-	1	-	-	49	-	-	51	-	-	-	-
Chicken Loaf	30	-	-	-	15	-	-	-	-	-	2,938	6	2	1	-	-	-	1	-	49	-	-	51	-	-	-	-
Frankfurter	20	-	-	-	10	-	-	-	-	-	1,931	-	1	-	-	-	-	-	-	49	-	-	51	-	-	-	-
Gr. Beef W/Sauce	20	-	-	-	10	-	-	-	-	-	1,931	-	-	-	-	-	-	-	-	49	-	-	51	-	-	-	-
Ham & Chicken Loaf	20	1	-	1	10	-	-	-	-	-	1,931	3	1	-	-	-	-	-	-	49	-	-	51	-	-	-	-
Pineapple	10	1	-	-	5	-	-	-	1	-	924	23	-	-	-	-	-	-	-	49	1	-	51	2	1	-	-
Pork Sausage Links	20	-	-	-	10	-	-	-	-	-	1,931	-	2	-	-	-	-	-	-	49	-	-	51	-	-	-	-
Cheese Spread	90	-	1	-	45	-	-	-	-	-	8,648	-	3	-	-	-	-	-	-	221	-	-	230	-	-	-	-
Jelly	80	-	3	-	40	-	-	-	-	-	7,724	3	12	-	-	-	-	-	-	196	4	3	204	5	1	3	-
Peanut Butter	70	-	-	-	35	-	-	-	-	-	6,800	4	3	-	-	-	-	-	-	147	-	-	179	-	-	-	-
Subtotal	510	2	4	1	255	1	3	1	1	1	48,282	67	33	5	1	2	1	2	1	1,226	5	7	1,302	7	2	5	1
Total No. Items Inspected		1,210	605					1,210			115,860								2,917			3,062					
Total No. Damages or Failures		16	9	17							296									35			35				
Percent Damage or Failure		1.32	1.48	1.40							.26									1.20			1.14				

APPENDIX I-K

CRITERIA FOR JUDGING PACKAGE PERFORMANCE

(Damage and Failure Analysis)

- Seal Failure - Separation of the package seal, allowing seepage of contents from package.
- Wall Failure - Bursting of package wall, allowing seepage of contents from package.
- Defective Seal- Includes seals which have not adhered uniformly along the sealing edge, ridges, or undulated surfaces; separation of inner seal, allowing product to seep in between upper and lower layers of the seal; and other failures of sealing machine to seal packages adequately.
- Sweller - Package swollen due to gas formed as a result of spoilage of food.
- Dirty Package- Package to which various colored stains or food particles are present on outer surface of item.
- Delaminated Pouch - Package in which there is a separation of the plastic-foil-plastic laminated materials.
- Moldy - Item found to be moldy upon opening of package.
- Pinhole - Small hole in packaging materials.
- Cut Package - Package which has been cut by some sharp instrument possibly during the packaging process.

APPENDIX I-L
EVALUATION OF UNIT LOAD
(Panama Shipment)

Load No.	No. Cases	General Condition of Load	Bulging, Sagging, Crushing, Tearing	Strapping	Insect infestation		Remarks
					Pallet	Case	
2	60	No visible damage	None	No straps rusted or missing. Straps sufficiently taut for load protection	Minor infestation of 1/3 of 1 deck board.	Minor infestation on outside of 3 cases. No damage to cases or components	Load would have withstood further storage and movement.
3	60	Minor damage to outer covering. No damage to cases or contents	4-in. tear in side wall of outer covering	No straps rusted or missing. Straps sufficiently taut for load protection	None	Minor infestation on outside of 3 cases. No damage to cases or components	Load would have withstood further storage and movement.
4	60	No visible damage	None	No straps rusted or missing. Straps sufficiently taut for load protection	None	None	Load would have withstood further storage and movement.
6	60	Minor damage to outer covering. No damage to cases and contents.	1 - 6-inch tear in score line of outer covering. 1 - 4-inch tear in edge of outer covering.	1 strap missing. No rusting of other 4 straps. Straps sufficiently taut for load protection	None	None	Load would have withstood further storage and movement.
7	60	No visible damage	None	1 strap missing. No rusting of other 4 straps. Straps sufficiently taut for load protection	None	None	Load would have withstood further storage and movement.
8	60	No visible damage	None	No straps rusted or missing. Straps sufficiently taut for load protection	None	None	Load would have withstood further storage and movement.
9	60	No visible damage	None	No straps rusted or missing. Straps sufficiently taut for load protection	None	None	Load would have withstood further storage and movement
10	60	No visible damage	None	No straps rusted or missing. Straps sufficiently taut for load protection	None	None	Load would have withstood further storage and movement.
11	60	No visible damage	None	No straps rusted or missing. Straps sufficiently taut for load protection	None	None	Load would have withstood further storage and movement.
13	60	Minor damage to pallet. No damage to cases or content	None	1 strap missing. No rusting of other 4 straps. Straps sufficiently taut for load protection.	None	Minor infestation on outside of 1 case. No damage to case or contents.	1 deck board of Pallet broken. Load would have withstood further storage and movement.

Note: Loads number 1, 5, 12 broken down for inspection upon arrival of shipment at Panama.

APPENDIX I-M

SUMMARY OF RESULTS OF AIRDROP BY PARACHUTE (HIGH VELOCITY)

Item	Total Items Dropped*	Major Failures (Mod.+Heavy)	
		Total	Percent
Apricots (dehy)	7		
Bacon	7		
Beans/Tomato Sauce	14		
Beef Loaf	3		
Beef Pattie (dehy)	4		
Beef Slices/Barb. Sauce	7	4	57.14
Beef Steak	7		
Beef Stew	7		
Bread Roll	70		
Cereal Bar	21		
Cheese Spread	32		
Chicken ala King	7		
Chicken Loaf	10		
Choc. Covered Cookies	21		
Choc. Nut Roll	7		
Cocoa Beverage Powder	11		
Crackers	14		
Date Pudding	7		
Frankfurters	7		
Fruitcake	7		
Gr. Beef/Pickle Flavor Sauce	7		
Ham & Chicken Loaf	7		
Jelly	28	3	10.71
Orange Nut Roll	7		
Peaches (dehy)	14		
Peanut Butter	24		
Pears (dehy)	7		
Pineapple	4	1	25.00
Pork Pattie (dehy)	4		
Potato Pattie (dehy)	21		
Pound Cake	7		
Raisin Nut Cake	3		
Pork Sausage Links	10		
Strawberries (dehy)	7		

Note: Examination of the above table shows that, of the 34 individual food items dropped, the failure rate for only one item was in excess of 25 percent. Based on the total number of food items dropped (34) and the total number of items with failure rate in excess of 25 percent (1), the overall failure rate was 2.9 percent or a recovery rate of 97.1 percent. While the Military Characteristics for aerial delivery with parachute does not specify a percent recovery rate, the failure rate incurred during this test is negligible and the test item satisfactorily meets the requirements for this method of aerial delivery when using standard delivery techniques.

* 12 cases were actually dropped, however, only 7 cases were inspected due to the negligible amount of damage. This table reflects damage to the contents of cases which were inspected.

APPENDIX I-N

SUMMARY OF RESULTS OF AIRDROP WITHOUT PARACHUTE

(Freedrop - Individual Cases Without Honeycomb)

Item	Total Items	Major Failures (Mod. + Heavy)	
	Dropped	Total	Percent
Apricots (dehy)	14		
Bacon	11		
Beans/Tomato Sauce	24	9	37.50
Beef Loaf	7		
Beef Pattie (dehy)	5		
Beef Slices/Barb. Sauce	12	9	75.00
Beef Steak	12	3	25.00
Beef Stew	11	5	45.45
Bread Roll	121		
Cereal Bar	35		
Cheese Spread	53	10	18.87
Chicken ala King	12	9	75.00
Chicken Loaf	20	1	5.00
Choc. Covered Cookies	35		
Choc. Nut Roll	12		
Cocoa Beverage Powder	18		
Crackers	23		
Date Pudding	12		
Frankfurters	12	4	33.33
Fruitcake	12		
Gr. Beef/Pickle Flavored Sauce	11	5	45.45
Ham & Chicken Loaf	12	1	8.33
Jelly	46	35	76.09
Orange Nut Roll	13		
Peaches (dehy)	24		
Peanut Butter	42	4	9.52
Pears (dehy)	12		
Pineapple	5	2	40.00
Pork Pattie (dehy)	5		
Potato Pattie (dehy)	36		
Pound Cake	11		
Raisin Nut Cake	7		
Pork Sausage Links	13	2	15.38
Strawberries (dehy)	12		

Note: Examination of the above table shows that, of the 34 individual food items dropped, the failure rate for 8 items was in excess of 25 percent. However, based on the total number of individual food items dropped (34) and the total number of items with a failure rate in excess of 25 percent (8), the overall failure rate was 23.5 percent or a recovery rate of 76.5 percent. Based on this analysis, the test item barely meets the minimum requirements of the Military Characteristics with regard to aerial delivery without parachute with 75 percent recovery. It is to be noted that six of the eight individual food items with major failures were the major food item within the respective menus. Therefore, the use of this aerial delivery technique is considered marginal in spite of the 76.5 percent recovery obtained in this test.

All items with a failure rate in excess of 25 percent were wet-pack items and generally those with a high liquid content.

APPENDIX I-O

SUMMARY OF RESULTS OF AIRDROP WITHOUT PARACHUTE

(Freedrop - Cases Lashed Together and Without Honeycomb)

Item	Total Items Dropped	Major Failures (Mod. + Heavy)	
		Total	Percent
Apricots (dehy)	5		
Bacon	4	1	25.00
Beans/Tomato Sauce	8	2	25.00
Beef Loaf	3	1	33.33
Beef Pattie (dehy)	1		
Beef Slices/Barb. Sauce	4	4	100.00
Beef Steak	4	3	75.00
Beef Stew	4	3	75.00
Bread Roll	40		
Cereal Bar	11		
Cheese Spread	17	7	41.18
Chicken ala King	4	4	100.00
Chicken Loaf	7	4	57.14
Choc. Covered Cookies	11		
Choc. Nut Roll	4		
Cocoa Beverage Powder	5		
Crackers	8		
Date Pudding	4		
Frankfurters	4	3	75.00
Fruitcake	4		
Gr. Beef/Pickle Flavored Sauce	4	4	100.00
Ham & Chicken Loaf	4	1	25.00
Jelly	14	10	71.43
Orange Nut Roll	4		
Peaches (dehy)	8		
Peanut Butter	15	2	13.33
Pears (dehy)	4		
Pineapple	1		
Pork Pattie (dehy)	1		
Potato Pattie (dehy)	11		
Pound Cake	4		
Raisin Nut Cake	3		
Pork Sausage Links	4	3	75.00
Strawberries (dehy)	4		

Note: Examination of the above table shows that, of the 34 individual food items dropped, the failure rate for 11 items was in excess of 25 percent. Based on the total number of individual food items dropped (34) and the total number of items with a failure rate in excess of 25 percent (11), the overall failure rate was 29.4 percent or a recovery rate of 70.6 percent. The test item does not satisfactorily meet the requirements of the Military Characteristics in this connection and this aerial delivery technique is not recommended for use.

APPENDIX I-P

SUMMARY OF RESULTS OF AIRDROP WITHOUT PARACHUTE

(Freedrop - Cases Lashed Together and With Honeycomb)

Item	Total Items Dropped	Major Failures (Mod.+ Heavy)	
		Total	Percent
Apricots (dehy)	4		
Bacon	4		
Beans/Tomato Sauce	8		
Beef Loaf	2		
Beef Pattie (dehy)	2		
Beef Slices/Barb. Sauce	4	2	50.00
Beef Steak	4		
Beef Stew	4		
Bread Roll	40		
Cereal Bar	12		
Cheese Spread	18		
Chicken ala King	4		
Chicken Loaf	6		
Choc. Covered Cookies	12		
Choc. Nut Roll	4		
Cocoa Beverage Powder	6		
Crackers	8		
Date Pudding	4		
Frankfurters	4		
Fruitcake	4		
Gr. Beef/Pickle Flavor Sauce	4		
Ham & Chicken Loaf	4		
Jelly	13	1	7.69
Orange Nut Roll	4		
Peaches (dehy)	8		
Peanut Butter	14		
Pears (dehy)	4		
Pineapple	2	1	50.00
Pork Pattie (dehy)	2		
Potato Pattie (dehy)	12		
Pound Cake	4		
Raisin Nut Cake	2		
Pork Sausage Links	4		
Strawberries (dehy)	4		

Note: Examination of the above table shows that, of the 34 individual food items dropped, the failure rate for 2 items was in excess of 25 percent. Based on the total number of individual food items dropped (34) and the total number of items with a failure rate in excess of 25 percent (2), the overall failure rate was 5.9 percent or a recovery rate of 94.1 percent. This delivery method satisfactorily met the requirements of the Military Characteristics in this connection and is the recommended method for use in the freedrop without parachute technique.

It is noted that the 2 items with a failure rate in excess of 25 percent were beefslices w/barb. sauce and pineapple, both of which have a high liquid content.

APPENDIX I-Q

SUMMARY OF WEATHER DATA

PANAMA STORAGE PHASE

DATE (1966)	Precip. (Inches)	UNCOVERED STORAGE				COVERED STORAGE			
		Temperature		R. H. ^a		Temperature ^a		R. H. ^b	
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Nov 29	1.55	82	76	100	66	82	72.5	100	.72
30	0.00	88	80	100	60	84	76	100	56
Dec 1	2.83	84	72	100	70	84	72.5	100	70
2	0.75	90.5	72.5	100	50	90.5	72.5	100	50
3	1.87	84	74	100	74	84.0	74	100	74
4	0.95	92	74	100	54	92	74	100	52
5	0.18	84	76.5	100	72	84	76.5	100	72
6	1.43	90	78	100	70	88	76	99	58
7	0.52	84	78	98	80	82	74.5	100	76
8	0.77	82	76	100	82	80.5	74	100	82
9	0.00	94	74.5	98	60	96	72.5	100	50
10	0.25	88.5	74	98	66	88	74	100	60
11	2.63	84.5	74	100	78	84	72	100	84
12	0.05	92	72.5	100	66	88	72	100	70
13	0.15	92	78	94	70	92.5	74	100	50
14	0.15	92	78.5	98	60	92	72.5	94	50
15	0.05	90.5	76.5	96	60	90	72	98	52
16	0.10	92	78.5	92	60	94	72.5	98	48
17	0.33	88.5	78.5	100	70	86	76	92	66
18	0.02	88.5	78.5	92	66	88	72.5	100	56
19	0.20	90	76	100	68	86	74.5	100	62
20	1.60	86	76	100	70	82.5	74	100	76
21	0.05	88	74.5	100	70	82	72	100	70
22	0.13	86	76	100	72	82	72	100	76
23	0.00	92	76	98	62	86	74	100	62
24	0.00	92	78	98	62	90	74	100	56
25	0.90	88	76.5	100	74	84	74.5	100	80
26	0.00	94	80	98	70	90	76	100	68
27	0.00	92	68	90	50	88	78	100	58
28	0.20	80	64	98	60	94	78	100	60
29	0.10	78	64	98	66	94	76	100	50
30	0.00	78.5	66	92	66	92	76	100	56
31	0.00	78	66	98	66	94	76.5	100	52

^aExpressed in degrees Fahrenheit.

^bExpressed in percent relative humidity.

APPENDIX I-Q
SUMMARY OF WEATHER DATA
PANAMA STORAGE PHASE

DATE (1967)	Precip (Inches)	UNCOVERED STORAGE				COVERED STORAGE			
		Temperature ^a		R. H. ^b		Temperature ^a		R. H. ^b	
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Jan 1	0.00	80.0	66.0	96	66	92.0	77.0	100	62
2	0.00	80.0	65.5	96	67	95.0	78.0	100	51
3	0.00	81.0	66.0	95	72	96.0	79.0	100	49
4	0.00	80.0	64.0	98	60	96.0	76.5	100	48
5	0.06	78.0	65.0	97	64	94.0	76.0	100	50
6	0.00	77.0	66.0	89	58	92.5	76.5	94	48
7	0.00	78.0	66.0	88	62	94.0	77.0	95	50
8	0.05	79.0	66.0	98	60	95.5	76.5	98	49
9	0.00	82.0	66.0	94	60	92.0	77.0	100	59
10	0.00	78.0	65.5	93	62	94.0	77.0	100	49
11	0.06	78.0	63.5	94	60	94.0	77.0	97	48
12	0.00	76.5	64.0	88	63	92.0	76.0	97	51
13	0.00	77.0	65.0	95	60	94.0	76.0	96	47
14	0.00	78.0	64.0	94	61	96.0	76.0	100	51
15	0.00	77.0	65.5	97	68	97.0	77.5	100	52
16	0.08	78.0	65.5	100	64	94.0	79.0	100	53
17	0.00	79.0	64.5	86	56	94.0	76.0	94	48
18	0.00	78.0	65.0	94	60	94.0	77.5	95	47
19	0.00	77.0	65.5	92	62	94.0	76.0	100	50
20	0.00	78.0	65.5	90	61	*	*	*	*
21	0.00	78.0	65.0	98	58	*	*	*	*
22	0.00	78.0	65.0	96	60	*	*	*	*
23	0.00	78.0	66.0	100	64	95.0	75.0	91	49
24	0.00	78.0	64.0	98	62	92.0	76.0	100	54
25	0.00	79.0	65.0	96	62	96.0	75.5	100	47
26	0.30	78.0	64.0	100	63	93.0	77.0	100	52
27	0.40	74.0	64.0	98	72	85.5	77.0	100	71
28	0.40	68.0	64.0	100	92	80.0	76.0	100	90
29	0.10	67.5	64.0	100	84	79.0	75.5	100	93
30	0.09	76.0	64.0	94	60	92.0	75.5	96	52
31	0.02	76.5	64.0	91	59	91.0	75.5	100	50

*Clock stopped.

^aExpressed in degrees Fahrenheit.

^bExpressed in percent relative humidity.

APPENDIX I-Q

SUMMARY OF WEATHER DATA

PANAMA STORAGE PHASE

DATE (1967)	Precip (Inches)	UNCOVERED STORAGE				COVERED STORAGE			
		Temperature ^a		R. H. ^b		Temperature ^a		R. H. ^b	
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Feb 1	.01	77.0	63.0	90	59	92.5	74.5	92	49
2	0.00	77.0	63.5	95	62	94.0	76.0	96	50
3	0.00	77.0	63.5	95	62	93.5	76.5	98	50
4	0.06	75.0	63.0	98	61	92.0	75.0	100	48
5	0.02	76.0	63.0	93	62	91.5	74.0	92	53
6	0.00	78.0	63.0	96	59	93.0	76.0	96	46
7	0.00	78.0	61.0	96	60	93.5	75.0	92	50
8	0.00	78.5	64.0	93	61	95.0	75.0	98	48
9	0.00	78.0	64.0	93	59	94.5	75.0	97	46
10	0.00	76.5	64.5	92	61	94.0	75.5	96	47
11	0.00	78.0	62.0	96	60	93.5	75.0	92	47
12	0.00	78.5	61.0	92	56	96.0	74.0	90	44
13	0.00	79.0	65.5	89	58	92.5	73.0	90	44
14	0.01	76.5	64.5	91	60	92.0	71.5	91	45
15	0.07*	*	*	*	*	*	*	*	*

*Charts and recorders taken out. End of storage phase.

^aExpressed in degrees Fahrenheit.

^bExpressed in percent relative humidity.

APPENDIX I-R

EVALUATION OF MEAL, READY-TO-EAT AFTER A 3-MONTH STORAGE PERIOD IN PANAMA

(Storage Stability Evaluation)

Storage Condition	No. Cases	No. Cases Inspected For Damage	No. Cases Damaged	Type of Damage	Remarks
Loose cases stored in warehouse palletized load stored outside covered with tarpaulin - 10 pallets x 50 cases each	48	48	0	N/A	None
	600	600	0	N/A	None
Loose cases stored outside on pallets and covered with tarpaulin	648	648	6	a. Hole gnawed through the sleeve and shipping case at the corner in each of 5 cases with 1 meal removed or destroyed from each case. b. Hole gnawed through the sleeve at the corner of 1 case. No damage to shipping case or contents.	The sleeve of all cases in the top layer of each pallet showed slight evidence of weathering. Insect infestations (ants and termites) were on the outside walls of 27 cases; however, none were found on the inside of the shipping cases and all meals were intact.
Loose cases stored outside on pallets, without covering	98	98	12	a. Hole gnawed into the side in each of 2 cases with entire contents removed or otherwise destroyed. b. Heavy water damage to individual meals in each of 6 cases. Fiberboard meal cartons were partially disintegrated. Packaging of components intact but covered with mold and slime. Suitability of foods for human consumption was questionable. c. Insects infestation (ants and/or termites) on the outside and inside of shipping cases and individual meal cartons in each of 4 cases. Components damaged and unuseable.	All cases in bottom layers of pallets showed evidence of insect infestation on outside of shipping cases. The outward appearance of all cases was good except that exposed surface areas of shipping cases and sleeve were weather-beaten with some bleaching of the fiberboard and slight separation of the fiberboard sleeve. Identification markings were still legible. Insects (ants) on the outside and inside of the shipping case of each of 13 additional cases but no damage to cases or meals.

APPENDIX I-S

OBSERVED CHANGES IN COMPONENTS OF THE MEAL, READY-TO-EAT AFTER A 3-MONTH STORAGE IN PANAMA

(Storage Stability Evaluation)

Component	Observed Change
Apricots (dehy)	Hard - Rehydration qualities affected
Cereal Bars	Dark color
Pineapple	Dark color -slightly sour, fermented taste
Bread Roll	Dark color
Pears (dehy)	Hard - Rehydration qualities affected
Cheese Spread	Coarse, grainy appearance
Choc. Covered Cookies and Brownies	Chocolate covering melted - adhered to wrapper
Chicken a la' King	Dark color' - coarse, grainy appearance
Date Pudding	Dark color - dry texture
Beef Slices w/BBQ Sauce	Thinner consistency of sauce
Cocoa Beverage Powder	Hardening of ingredients in some packages
Accessory Packets (food components)	Hardening of some packages of catsup mix, cream, and all soup and gravy base, beef.

APPENDIX II. FINDINGS

Key
 MC-----Military Characteristics
 TC-----Technical Characteristics

Requirements	Findings
1. MC 19a: Packaging shall be compatible with the pockets of field clothing.	Requirement met (Par. 2.3).
2. MC 19b: Shall be of minimum weight and bulk consistent with other requirements. Gross weight will not exceed 1 pound.	Requirement not met. Gross weight exceeds 1 pound per menu (Par. 2.2).
3. MC 19 c. The case in which the meals are packaged shall be of minimum weight and bulk consistent with other requirements. Gross weight will not exceed 25 pounds.	Requirement met (Par. 2.2).
4. MC 19d: Components shall be packaged to the maximum extent in flexible containers.	Requirement met (Par. 2.2).

APPENDIX II

Requirements	Findings
5. MC 20a: Shall provide an adequate quantity of food for one man for one meal, all meals to be essentially equivalent in nutrition so that any three meals will constitute a ration.	Requirement met (Par. 2.6 and 2.7).
6. MC 20b: Shall be acceptable for consumption over a period of one week as a sole diet.	Requirement met (Par. 2.7).
7. MC 20c: Shall conform to nutritional requirements.	Requirement met (Par. 2.6).
8. MC 20d: Shall be acceptable when consumed hot or cold.	Requirement met (Par. 2.7)

APPENDIX II

Requirements	Findings
<p>9. MC 20e: Shall require no preparation other than opening packages and shall require no water except for the reconstitution of drink.</p>	<p>Requirement met (Par. 2.2).</p>
<p>10. MC 20f: Shall include all accessories necessary for consumption of the meal, except canteen, canteen cup, and water.</p>	<p>Requirement met (Par. 2.2).</p>
<p>11. MC 20g: An accessory packet containing cigarettes, matches, toilet paper, chewing gum, and cleaning patches will be included with each meal.</p>	<p>Requirement met (Par. 2.2).</p>
<p>12. MC 20h: An expendable means of heating the meal will be provided.</p>	<p>Requirement met (Par. 2.2 and 2.10).</p>

APPENDIX II

Requirements	Findings
13. MC 21. a. Cases and packages shall be water, insect, and rodent resistant.	Requirement met (Par. 2.5).
14. MC 21. b. Cases and packages shall be marked and markings shall remain legible under all conditions encountered in storage, transport, and distribution.	Requirement met (Par. 2.8).
15. MC 21c. Shall be capable of withstanding military handling during transportation and storage prior to use.	Requirement met (Par. 2.8).
16. MC 21d. Cases and packages shall be easily opened. If an opener is required for this purpose, it will be provided with each meal.	Requirement met (Par. 2.10).

APPENDIX II

Requirements	Findings
17. MC 21e. This ration shall be capable of storage without refrigeration for a minimum of 2 years (a longer period is desirable) without spoilage or detrimental decrease in nutritional value or palatability.	Not determined.
18. MC 22a. Suitable for all means of transportation including animal pack and man-carry.	Requirement met (Par. 2.8 and 2.9).
19. MC 22b. Capable of aerial delivery by parachute.	Requirement met (Par. 2.9).
20. MC 22c. Capable of aerial delivery without parachute with assurance of 75% recovery.	Requirement met (Par. 2.9).

APPENDIX II

Requirements	Findings
21. MC 23. Associated equipment - None	N/A
22. MC 24. Environmental and terrain requirements - Safe storage and transit temperatures shall conform to AR 705-15 as amended.	Requirement partially met. Adverse changes in the rehydration qualities of the dehydrated fruits were noted when the meal was subjected to temperatures of 100°F and above (Par. 2.12).
23. MC 25. CBR and atomic requirements - Cases and packages shall be at least as resistant to CBR and atomic effects as current standard item.	Complete results are not available with respect to Chemical and Biological evaluation. Requirement met with respect to radiological and atomic effects (Par. 2.11).

APPENDIX II

Requirements	Findings
24. TC 2a: Nutritional adequacy: Meals will be designed so that any three provide the daily nutritional requirements set forth in AR 40-564 (including 3600 calories) for one man, and any one meal provides 1/3 the daily nutritional requirement (including 1200 calories) for one man.	Requirement met (Par. 2.6).
25. TC 2b: Acceptability: At least 12 meals will be designed so that any one meal is suitable for breakfast, dinner, or supper and any three are suitable as a ration. Food components will be developed in terms of maximum acceptability when eaten cold; variety will be sufficient to avoid rejection when the Meal, Ready-to-Eat, Individual, is consumed as the sole diet over a period of one week. Human engineering principles will be applied throughout development of food components.	Requirement met (Par. 2.7 and 2.13).
26. TC 2c: Stability: All food components, in the packaging used for the Individual Ready-to-Eat Meal, will be capable of withstanding at least six months at 100°F. without significant loss of nutritional adequacy, edibility, acceptability or utility, and will be capable of withstanding repeated freezing and thawing involving exposure, in the ration case, to temperatures as high as 125°F. for as long as two hours per day, and as low as minus 65°F. without significant loss of nutritional adequacy, acceptability, and utility.	Requirement partially met. A significant loss in palatability of certain items was found when the experimental meal was stored at 100°F. for 6 months. Further, adverse changes were noted in the rehydration qualities of dehydrated fruits when exposed to temperatures of 100°F. and above (Par. 2.12).

APPENDIX II

Requirements	Findings
<p>27. TC 2d: Utility: The meals will require no preparation other than opening of packages and no reconstitution except of beverage components. Lightweight packaging capable of use as a heating vessel under conditions permitting heating will be used. The meal package will contain all accessories needed for consumption of the meal except canteen, canteen cup and water. Gross weight of each meal will not exceed one pound; gross weight of packed shipping containers will not exceed one pound; gross weight of packed shipping containers will not exceed 25 pounds. The configuration of each meal will be compatible with pockets of field clothing. Cases in which the meals are packed will be designed for aerial delivery without parachute with assurance that 75% of the contents will be suitable for consumption within 24 hours after the cases are dropped on representative terrains at speeds and from altitudes normally used by Army rotary and fixed wing aircraft in support of tactical operations.</p>	<p>Requirement partially met. Gross weight of menus exceeds the 1 pound limitation (Par. 2.2, 2.3 and 2.9).</p>
<p>28. TC 3: Components: The Meal, Ready-to-Eat, Individual, will consist of 12 meals in lightweight packages containing all required accessories and materials needed to prepare and eat the meals except canteen, canteen cup, and water. An expendable means of heating the meal will also be provided separately and not as a meal component. The food components will be processed by whatever methods prove most successful in meeting the military characteristics; maximum use will be made of precooked foods processed by novel or improved thermal or other relevant methods; when the state of the art permits, precooked radiation processed components will be included.</p>	<p>Requirement met (Par. 2.2).</p>

APPENDIX III. DEFICIENCIES AND SHORTCOMINGS

1. DEFICIENCIES

<u>Deficiency</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
1.1 The presence of spoiled foods or foods of questionable condition in the ration and defective packaging suggests a possible safety hazard to the user (Par. 2.2, 2.8, and 2.15).	Improvements or refinements in processing and packaging techniques and quality control measures which are necessary to assure that the Meal, Ready-to-Eat are as free from materiel and processing defects as present knowledge and the current state-of-the-art will permit.	None

2. SHORTCOMINGS

<u>Shortcomings</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
2.1 The gross weight per meal exceeds the 1 pound limitation (Par. 2.2).	Corrective action cannot be determined.	None
2.2 The packaging of the plastic spoons was, ruptured or torn thereby not providing adequate protection from a sanitation standpoint (Par. 2.2).	Redesign the packaging or spoon so that packaging will not rupture or tear in normal shipping and handling operations.	None
2.3 The perfumed odor of the cleansing towel was objectionable from a security standpoint (Par. 2.2).	Eliminate all strong odors from cleansing towels.	None

APPENDIX III

Remarks

Suggested Corrective Action

Improve palatability of these items.

None

None

Replace cereal bars with an acceptable item.

None

Improve storage stability of these components.

None

Improve rehydration qualities.

Remarks

Corrective Action

None

None

Shortcomings

2.4 Bread and chocolate nut roll are only marginally acceptable (Par. 2.7).

2.5 Apricot and orange cereal bars are unacceptable (Par. 2.7).

2.6 Seventeen of the 40 food components showed a significant decrease in palatability after storage for 6 months at 100°F. Seven of these are major components in 7 different menus (Par. 2.12).

2.7 The rehydration time for dehydrated fruits after 6 months' storage at 100°F. and after shorter periods at higher temperatures is excessive (Par. 2.12).

3. CORRECTED DEFICIENCIES AND SHORTCOMINGS

Deficiency/Shortcoming

3.1 None

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13. Letter, U. S. Army Natick Laboratories, AMXRE-FPC, 11 May 1967, subject: "Engineering/Service Test of Meal, Ready-to-Eat, Individual, TECOM Project 8-3-7400-06."

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One deficiency and seven shortcomings were found. The deficiency was a safety hazard to the user because of spoiled foods and defective packaging. It was concluded that: the experimental ration menus are less acceptable from a palatability standpoint than the standard menus when consumed both hot and cold; the level of ratings of the components of the experimental meal

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though generally acceptable are such that overall improvements are indicated particularly in the bread and cake items; and the experimental meal is not suitable for Army use under intermediate climatic conditions.

It was recommended that: the palatability of the components of the Meal, Ready-to-Eat, be improved to a level of acceptance that is at least equal to that for the standard meal; the cereal bars be replaced with an acceptable component; the Meal, Ready-to-Eat, Individual, be considered not suitable for use by the Army under intermediate climatic conditions until the deficiency and as many as possible of the shortcomings are corrected; and the modified meal be returned for a Check Test.

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It was recommended that: the palatability of the components of the Meal, Ready-to-Eat, be improved to a level of acceptance that is at least equal to that for the standard meal; the cereal bars be replaced with an acceptable component; the Meal, Ready-to-Eat, Individual, be considered not suitable for use by the Army under intermediate climatic conditions until the deficiency and as many as possible of the shortcomings are corrected; and the modified meal be returned for a Check Test.

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